SCIENCE

NEW SERIES. VOLUME LVIII

JULY-DECEMBER, 1923

NEW YORK
THE SCIENCE PRESS
1923

CONTENTS AND INDEX.

NEW SERIES. VOL. LVIII.—JULY TO DECEMBER, 1923

THE NAMES OF CONTRIBUTORS ARE PRINTED IN SMALL CAPITALS

SCIENCE

VOL. LVIII JULY 6, 1923 No. 1488

CONTENTS

SCIENCE: A Weekly Journal devoted to the Advancement of Science, publishing the official notices and proceedings of the American Association for the Advancement of Science, edited by J. McKeen Cattell and published every Friday by

THE SCIENCE PRESS

Lancaster, Pa. Garrison, N. Y.

New York City: Grand Central Terminal.

Annual Subscription, $6.00. Single Copies, 15 Cts.

Application made for transfer of entry as second-class matter to the Post Office at Lancaster, Pa.

THE SIGNIFICANCE OF THE INTERNAL RETICULAR APPARATUS OF GOLGI IN CELLULAR PHYSIOLOGY[1]

IT is natural for us to attempt to reduce physiological activities to a cellular basis. The cells of which we are composed are in a very real sense vital units. Some of them continue to survive many hours after death, and, while we live, many of them are continually dying. But we ought not be disappointed if examination under very high powers of the microscope fails to reveal any definite structural groundwork in the cytoplasm. That it is not homogeneous, as it often appears to be, does not require proof, for chemical and physical homogeneity would be inconsistent with physiological activity. We must have some faith in things unseen; we must extend our conceptions to include the morphology of the ultramicroscopic and invisible; otherwise we fail.

Like a great factory, the cytoplasm must be spacially organized for the separation and integration of chemical reactions. Industries are coordinated through trade; the cells by the blood stream. But the cell is many times more efficient than any factory. Within its small compass it rapidly brings about chemical changes which are only possible outside the body at high temperature and with the aid of much complicated machinery. It is marvelously well regulated and works with wonderful harmony. The analogy is, of course, hopelessly inadequate, but it is nevertheless useful for our purpose. As in a factory, certain areas of the cytoplasm are set apart to perform specific duties. I have in mind, for example, the contractile portion of the muscle cell and the secretory pole of the gland cell. The most recently recognized area and the one about which we know the least appears in many cases to be of fluid nature. It has been called the Golgi apparatus after its discoverer, but the term "apparatus" is unfortunate because it suggests a mechanism of a rather inanimate type. With the dawn of an era of experimentation in technique, much attention is being paid to this portion of the cytoplasm. Already the literature has become so unwieldy that to save valuable time we gladly avail ourselves of carefully constructed reviews, like those of Duesberg, Cajal and Pappenheimer, to determine what has or has not

[1] Eighth Harvey Lecture delivered at the Academy of Medicine, New York, March 10, 1923.

been done. It is indeed a striking commentary upon the domination and apparent self-sufficiency of classical methods of cytological analysis that this cytoplasmic constituent, which frequently occupies an area as large as the nucleus, should have remained almost unnoticed for so long.

(1) *Morphology:* As a result of the discovery that the apparatus is argentophile after certain fixatives (Golgi) and that it may be blackened by prolonged treatment with 2 per cent. osmic acid (Kopsch), many facts have come to us regarding its shape. In the somatic cells of mammals and the majority of vertebrates it is usually encountered in the form of a more or less dense network consisting of anastomosing strands of uneven girth but of smooth outlines. It may be closely drawn together into a rather compact mass, or dispersed throughout the cytoplasm in isolated fragments, as is often the case in nerve cells. It is never of exactly the same morphology even in neighboring cells of the same kind, which indicates great ability and has given rise to the belief that it may be changing in shape from moment to moment.

In attempting to understand changes in form, we have to be on our guard, because slight variations in technique may result in networks which are either unusually robust or else thin and anemic looking or in the complete disintegration of the apparatus into droplets of irregular size. But well-controlled preparations do show conclusively that the shape of the apparatus is in a general way typical of different cell types. For instance, its appearance is quite characteristic in acinus cells of the pancreas and polymorphonuclear leucocytes—in the one it is a large network of coarse meshes located between the nucleus and the lumen, in the other it is a small rather dense mass to be found in the cytoplasm in the concavity of the nucleus. Furthermore, if glands like the submaxillary and thyroid are examined in several different groups of animals the same general style of Golgi apparatus is repeatedly met with. In other words, variations in its morphology are probably very closely related to variations in cellular organization and function.

In the lower metazoa the information at hand appears to show that generally speaking the Golgi apparatus is rather prone to occur in disconnected fragments, instead of in the form of complicated networks. Particularly is this true in stages of oogenesis and spermatogenesis. Isolated masses are also to be detected in the protozoa. To this circumstance is due the practice of some authors in speaking of Golgi "bodies." The word "body" unavoidably carries the impression of distinctive form and to some extent of solidity as contrasted with relative fluidity.

(2) *Occurrence:* Material resembling the typical Golgi apparatus, as it was first described in the nerve cells of mammals, is of very wide occurrence. If we search through the cells of the human body we find it present in each and every one except in those which are dead and dying, like non-nucleated red blood cells and desquamating epidermal cells. Not only does a Golgi apparatus occur in all embryonic cells, but with growth and differentiation, it undergoes a definite sequence of changes, suggesting, as pointed out by Bensley, that we have to do with a material which behaves as a unit in the developmental cycle. In the phylogenetic series we are confronted by a similar condition of affairs. It is safe to say that a Golgi apparatus or its representative has been seen in all vertebrates which have been properly examined, also in many invertebrates, and in plants (Laburu and others.) In establishing homologies, however, it is necessary to keep before us the fact that we are actually dealing with mixtures of unknown substances which vary in density as compared with the ground substance, so that as yet we are only permitted to outline the probable distribution of the Golgi apparatus, with due qualifications and in the most tentative way. Borderline cases are perplexing because the properties of the material unquestionably vary progressively in the life history of specialized cells so that it is difficult to say when we are dealing with a true Golgi apparatus or with substances which may be in part its products—an uncertainty which is also encountered in dealing with mitochondria. With our present technique we may just skim the surface and recognize a few of its most general attributes. When, after further experimentation, we are able to examine it more closely, with really refined methods, it is quite possible that we shall find distinctive variations in cells of different categories. As in other biological problems, so also here a close study of morphology and behavior must precede chemical and physiological analysis.

In our analogy of the factory, it is like the discovery of the existence in all manufacturing plants the world over of rather pretentious buildings, characterized by certain distinctive architectural features and built of materials almost wholly unknown to us.

(3) *Size:* Some cells are evidently fitted to perform their duties with a large Golgi apparatus (gland cells) and others with a relatively small one (muscle cells). We know also that the Golgi apparatus is usually well developed in the active stages of cytomorphosis, that it becomes gradually smaller as the cell ages (except in plants) until it finally disappears with senility and death. There is also satisfactory evidence to the effect that this peculiar cytoplasmic area becomes enlarged in certain pathological conditions. For instance, Tello discovered a marked degree of hypertrophy in tumors of the mammary gland and his results are in harmony with an increase

in the size of the apparatus which Da Fano subsequently noticed in the mammary gland during pregnancy and lactation. Other instances might be cited, but we shall do well to err if anything upon the side of conservatism in recording experimental changes and to accept only alterations which are very pronounced, because slight variations in size occasionally occur spontaneously without apparent rhyme or reason. Some of them may be due to slips in technique or to the influence of changes in light or temperature upon the silver reaction or the blackening with osmium. For the present an accurate quantitative determination of the Golgi apparatus is beset with almost insurmountable difficulties. Nobody has yet attempted to establish a definite Golgi apparatus—cytoplasmic ratio on the basis of relative volumes. We cannot even say, with confidence, whether the material is present in relatively larger amounts in protozoa or in man.

Passing now to a consideration of the actual mechanism of changes in size we at once plead complete ignorance. There has, however, been no dearth of speculation. On cell division the networks are broken up into smaller masses (resembling perhaps the Golgi "bodies" of lower forms) which are distributed approximately equally to the two daughter cells, in which the networks are again reconstituted. Sometimes this process is characterized by great regularity; at other times it has the appearance of being rather haphazard. Attempts have not been wanting to bring the so-called "Golgi bodies" into line with other cytoplasmic components, especially the plastids of plants, which are, at least in some cases, self-perpetuating and multiply by direct division without loss of their individuality. Gatenby in particular has come out squarely with the declaration that "both mitochondria and Golgi bodies are able to assimilate, grow and divide in the cytoplasm somewhat as a protist assimilates, grows and divides in a watery medium." By this he does not intend to imply that they are symbiotic organisms. He wishes only to indicate that they possess a marked degree of independence. He is not alone in this contention, but the idea of the individuality of chemical substances, expressed in relation to the Golgi apparatus, in a system which is itself a coordinate whole, does not make a strong appeal to those of us who have been chiefly occupied with the somatic cells of vertebrates in which the networks frequently attain to a high degree of complexity and in which they often undergo hypertrophy without preliminary fragmentation into small aggregates. Under these circumstances, growth by some process of accretion seems more likely to prevail.

(4) *Position*: Another point of interest, and we trust of immediate practical importance, is that the Golgi apparatus appears to move about in the cytoplasm in a remarkable and orderly manner. In cells of fixed secretory polarity, like the acinus cells of the pancreas, which have already been mentioned, and the cells of the salivary glands, it is always placed between the nucleus and the discharging pole. In the thyroid, on the other hand, I have found that, at least in the adult guinea pig, it normally migrates from one end of the cell to the other. That is to say, from its usual position between the nucleus and the lumen it may approach the lumen or flow around the nucleus to the opposite end of the cell adjacent to the peripheral vascular network. This reversal may take place in entire follicles or within single cells. There seems to be a kind of ebb and flow. In order to view this phenomenon in true perspective, we may recall that the position of the Golgi apparatus is subject to great variation in the cells of the choroid plexus, studied by Biondi, and that a somewhat similar but progressive change in its position has been noted by Golgi in mucus-secreting intestinal epithelial cells.

Since we have reason to believe that the thyroid differs from other glands like the pancreas in being able, under conditions which are but little known, to pour its secretion directly into the peripheral vascular network, I made the suggestion, in January of last year (1922), that we have in these migrations a real indicator of physiologic reversals in polarity. If this theory is confirmed experimentally, preparations of this type revealing the position of the Golgi apparatus will afford accurate information regarding the direction of secretion at the time the tissues are taken. In this way it may well be possible to effect a close correlation between the actual discharge of thyroid secretion and the response by the organism to its action. I also suggested that an examination of the Golgi apparatus in the parathyroids and the hypophysis, in both of which intracellular secretion antecedents remain to be discovered, might yield clues regarding the direction of discharge, but preparations were made of these tissues from adult guinea pigs without my being able to discover any definite orientation on the part of the apparatus.

But the probability of success with the thyroid is clearly indicated by Masson's paper on the position of the centrosomes in malignant thyroid tumors published last June (1922). It has been abundantly shown that the centrosomes are often closely related in a topographic sense to the Golgi apparatus. Like the Golgi apparatus they usually occur in thyroid cells between the nuclei and the lumen. But in tumor cells Masson found them to migrate in the direction of the peripheral blood vessels. In one of his illustrations it may be seen that, though most of them are in the usual position, a few are reversed. In another, all are reversed and the colloid has disappeared from

the lumen and has accumulated about the peripheral blood vessels. The follicles seem to have been turned completely inside out in respect to the direction of secretion. Successful preparations of the Golgi apparatus would probably have revealed the same phenomenon.

Last April, Courrier and Reiss published a short note dealing with the position of the Golgi apparatus in the parathyroids of new-born kittens. With the apparatus as an indicator, they claim to have established the existence of a definite secretory polarity and the presence of a network of capillaries of two types. They believe that at this stage the cells are arranged in cylindrical columns, the surfaces of which are bathed by nutritive capillaries and the central areas drained by others of excretory nature, and that the position of the Golgi apparatus between the nucleus and the central capillary indicates the existence of a definite functional polarity. The authors point out that this discovery of polarity opens up a somewhat new conception of endocrine cells, it having been customary thus far to deny the presence of definite secretory polarity in all of them except the thyroid. They call attention, for example, to Van der Stricht's claim that the lutein cells may secrete from any point of their surface—*i.e.*, that they are apolar—and to the fact that Colson is of the same opinion in respect to the cortical cells of the suprarenals. Now the possibility is raised that other cells, in addition to those of the parathyroids, may be definitely polarized. This information supplied by Courrier and Reiss, if confirmed, may be useful in helping us to find true secretion antecedents in the parathyroids. When we know the pole of the cell from which the secretion is discharged, we shall at least know where the antecedents are likely to be most concentrated.

In a second paper published in June, Reiss made a study of the position of the Golgi apparatus in the secretory cells of the anterior lobe of the cat's hypophysis. What he found is indeed most striking. As a preliminary to the discussion he remarks that, from the work of Stewart and others, it seems likely that the three types of cells with which we have to deal are closely related. From being chromophobe, they become basophile and then acidophile. In the first named, the apparatus is, according to Reiss, without special orientation which corresponds nicely with the view that these cells are resting. In the basophile cells it is invariably found between the nucleus and the periphery of the cluster, and finally in the acidophiles it is located between the nucleus and the central area. Reiss claims to have observed all transitional stages in this sequence. His interpretation is that we have a mechanism by which the cells are able in one stage to pour a secretion toward the periphery and then to turn about face and discharge a second and different product into the center of the cluster. It is questionable whether these suggested oscillations in secretory polarity could have been detected without the clue offered by the migration of a conspicuous structure like the Golgi apparatus. We naturally await confirmation of Reiss's work with some eagerness.

A significant observation to be emphasized is that reversal in the position of the Golgi apparatus may also be induced experimentally in tissues in which it does not occur normally. D'Agata discovered a change in position in epithelial cells of the newt's stomach following scarification, and Basile found that it could be reversed in the cells of the straight and convoluted tubules in one kidney through the extirpation of the other. From its normal position between the nucleus and the lumen it migrates to the opposite pole facing the peripheral blood-vessels. Unhappily, these observations have not been confirmed, but the illustrations presented by Basile are so clear and convincing that it is difficult to imagine how he could have gone astray. But we must not be premature and hasten to the conclusion that the purpose of the Golgi apparatus is to elaborate secretion, because we find it to be equally highly developed in nerve cells and in others in which secretory activities are not pronounced. Neither can we say that in gland cells it is wholly unrelated to the formation of secretion, since so marvelous an integrating and unifying principle is manifest in all vital processes. We have to steer a middle course. What the observations which I have related do show is that we are now able to follow significant changes in the position of an important and hitherto unrecognized cytoplasmic area. From the technical point of view we are on firmer ground than in the study of variations in the shape and size of the Golgi apparatus, inasmuch as it is altogether unlikely that any error in manipulation would constantly bring about so definite a shifting in the relative position of parts of the cytoplasm.

To return again for a moment to our confessedly inadequate analogy of factory organization, it is as if the above-mentioned large and unknown buildings, presumably containing machinery vital to the industry, were found to be capable of undergoing periodic migrations to the other end of the lot.

(5) *Constitution:* Thus far stress has been placed upon objective findings which are subject to verification. Unfortunately, any logical and comprehensive interpretation which will fit all the facts is a thousandfold more difficult. We are not even justified at this time in hazarding speculations as to what is going on within this newly discovered region of the cell, although several investigators have not shown any reluctance to express their views on the subject. It has already been intimated that while our methods

are so crude we can not exclude the possibility that under the same heading we are grouping a variety of formations. The affinity of the Golgi apparatus for silver salts after appropriate fixation has been mentioned and the ease with which it may be blackened by prolonged immersion in osmic acid. It may occasionally be stained with iron hematoxylin and resorcin fuchsin. Either it or one or more of its components are soluble in alcohol, for unless preparations are dehydrated very promptly no trace of it remains. It has been repeatedly asserted that the Golgi apparatus is at least partly of lipoidal nature. According to Gatenby, it has in this respect much in common with mitochondria. Bowen is of the opinion that the Golgi bodies observed in insect spermatogenesis are made up of two components, one staining darkly and the other lightly—an idea which has been elaborated by subsequent investigators, but I see no good reason to suppose that the Golgi apparatus in the somatic cells of higher vertebrates is heterogeneous in the same sense.

The chief obstacle is that the Golgi apparatus can not be clearly seen in living unstained cells examined in approximately isotonic media—to be specific, in mammalian tissues, because several workers claim to have observed Golgi bodies in the living cells of certain invertebrates. Nor has it been possible to stain the material with vital dyes, although many have been tried. This small branch of cytology has in fact advanced about as far as did our knowledge of mitochondria before the introduction of janus green. At that time there were many "doubting Thomases" who have since been converted. We hope and expect a similar development in the case of the Golgi apparatus. But in fairness we are obliged to admit that, as revealed to us in fixed preparations upon which we must for the moment rely, it is an artefact in the sense that it conveys an impression which does not fully or accurately represent the condition of affairs in the living cell. We suspect that the dense black outlines give rise to a false idea of relative solidity for the reason that when cells are carefully crushed under the microscope it may be seen that the mitochondria and other granules have freedom of motion and that they are not impeded by the presence of a semi-rigid network in the area which we know to be occupied by the Golgi apparatus. I have found, moreover, in the thyroid that it is by no means a simple matter to displace the Golgi apparatus by centrifugation, from which it is safe to deduce that it is, in the tissue examined, of about the same specific gravity as the remainder of the cytoplasm.

(6) *Reactions to injury:* It was soon shown by Cajal and other investigators that the Golgi apparatus is very sensitive to autolytic influences. In nerve cells removed from the body it loses, within a very few minutes, its distinctive net-like form and breaks up into a very fine dust-like deposit. The sequence of alterations following experimental injury to nerve cells has been the subject of several papers first by Marcora and later by Cajal and Penfield. As a result, the apparatus becomes dispersed into the peripheral cytoplasm and finally disappears completely. In phosphorus poisoning I have noted a corresponding fragmentation but no peripheral migration. It is a singular fact that unlike the mitochondria (W. J. M. Scott) the Golgi apparatus takes little or no part in the ensuing fatty degeneration.

The time at my disposal forbids reference to further work along this line except to make the general comment that investigators in biology and medicine have not been slow to grasp the fact that the Golgi apparatus offers an entirely new criterion of cell injury, the study of which may yield surprising results of far-reaching importance. It is to be regretted that the problems involved have not always been approached in a spirit likely to bring adequate returns. In recent years cytology has become a very highly specialized science and must be treated with due respect. Nobody would launch forth upon a complicated chemical analysis without adequate training in chemistry. Disappointment would follow as surely as day follows night. The instances are exactly parallel. No matter how detailed are the instructions, a technician can not be expected of his own initiative to follow them successfully and to arrange for suitable controls. The investigator himself must buckle right down to work, and prepare himself for some disappointments, if he is to reap the reward. In a study so delicate it is even within the bounds of possibility that trained individuals looking eagerly for some distinctive changes will all unconsciously be influenced to report some deviation from the normal, especially when the normal is not readily established, as in the case of human tissues removed at operation or at autopsy. It is open to serious question whether the study of mitochondria has not also suffered grievously from the hastily planned and ill-considered observations of investigators who are masters in their own fields and have simply been attracted by the shimmer of something which is strange and new.

(7) *Relation to the so-called canalicular apparatus:* Before concluding this address, brief mention should be made to a kind of evidence which we apprehend only dimly but which seems to shed some light upon the nature of the materials which we have under consideration. About the time that Golgi announced his discovery (1898), Holmgren and other workers found a system of clear canals within the cytoplasm of a large variety of cells belonging to the same categories in which the presence of the Golgi

apparatus was being reported. They were seen after many fixatives, but especially trichlorlactic acid, and exhibited the property of remaining uncolored when the rest of the cytoplasm was stained. Their close resemblance in form and position to the apparatus of Golgi attracted widespread attention, so much so that Cajal was led to propose the name of Golgi-Holmgren canals to include both formations. This action, however, has not pased unchallenged. Duesberg has reacted strongly against its unqualified acceptance. He is of the opinion that the two formations are identical in neurons and non-nervous cells which possess a localized trophospongium (canalicular system) but that in non-nervous cells with a diffuse trophospongium spread throughout the cytoplasm they can not be the same because the Golgi apparatus is restricted to one pole of the nucleus.

We note also that Penfield has found distinctive changes in the morphology and position of the Golgi apparatus in nerve cells after section of the posterior nerve roots. And, further, that when the same cells were bleached and stained with iron hematoxylin he was able to observe a system of clear canals in the cytoplasm which in no way corresponded with the remnants of the Golgi apparatus. He naturally concluded that the clear canals and the blackened Golgi apparatus are two entirely different formations. These observations merit very careful consideration. A close examination of his figures shows that the clear canals which he found are not exactly the same as the canalicular apparatus in normal nerve cells. The canals are angular and to some extent suggestive of shrinkage spaces; they are abundant in the peripheral cytoplasm and in some cases appear as if they might penetrate into the cell from without; whereas in normal cells of the same kind the canalicular apparatus presents rounded contours and is usually situated in the intermediate zone of the cell, leaving a layer of cytoplasm immediately about the nucleus and just beneath the cell membrane clear. This may mean that we are dealing with a canalicular apparatus distinctively changed by section of the nerve roots or that we are confronted by an altogether different type of tubular system.

It is, I think, significant that von Bergen discovered in certain nerve cells shreds of blackened material within clear canals—an observation which has led investigators to infer that the clear canals contain a fluid which is argentophile, osmophile, soluble in alcohol and exhibits all the properties which we are accustomed to refer to the Golgi apparatus. Though I have been unable to repeat this observation of von Bergen, I have obtained similar but less striking information pointing in the same direction. In nerve cells the clear canals, like the blackened apparatus, may be diffuse, eccentric or circumnuclear in position after fixation in formalin, trichlorlactic acid and osmic acid. The same three morphologic types are seen after staining with Weigert's hematoxylin. What appear to be transitions may be detected between clear canals and aggregates stainable with resorcin-fuchsin, and also between clear canals and osmic acid-blackened masses. In other words, in both instances there seems to be a progressive increase of the stained material at the expense of the clear canals. My preparations suggest positive and negative impressions of one and the same thing. In the pancreas I have bleached out the blackened networks and find in all cases a corresponding system of clear canals remaining, although the size of the cells is altered by the repeated hydration and dehydration. But it is unsafe to go as far as to claim that the clear canals and the blackened reticula occurring in all cells are visible expressions of the reactivity of one and the same cytoplasmic area.

We know that clear, chromophobe spaces in the cytoplasm are not always of the same origin. They may represent areas from which the mitochondria have been dissolved; instead of being restricted to a definite location they may be experimentally produced throughout the cytoplasmic area; in some cases pointed clefts which are apparently technical artefacts may be continuous with a canalicular apparatus in its proper location. And these are not the only possibilities that complicate the problem. Repeated attempts on my part to make clear canals artificially in mixtures of gelatin and lecithin, fixed by methods designed to reveal the canalicular apparatus, have not been particularly fruitful. Preparations made in this way and stained with iron hematoxylin contain canals and vacuoles of many sizes. By careful selection, however, it is possible to gather together a series of canals which resemble to some degree the intracellular formations which so perplex us. That intracellular canals are not always fixation artefacts may be concluded from Bensley's observation that they may be seen in living islet cells of the pancreas. But the mere act of taking living cells from the body and of bringing them under the microscope for study may, and probably does, initiate changes in the cytoplasm which may be wholly or in part responsible for the appearances in question.

The same investigator made a parallel study of the clear canals in plant and animal cells by improved methods of technique. Through the study of both living and fixed tissues he found a very significant series of changes in growing cells of the onion tip. In the youngest cells he discovered a system of clear canals, agreeing in many details with those brought to light by the same methods in animal cells. With increase in age the canals enlarged and finally gave rise to the familiar plant cell vacuole. On the basis

of these observations he suggested "that the network of canals found in so many animal cells is the physiologic and morphologic equivalent of the vacuolar system in the plant cell." This far-reaching generalization has recently (1922) received support from the botanists, Guilliermond and Mangenot. These investigators worked with barley cells and arrived at a similar conclusion by employing methods adapted to the demonstration of the Golgi apparatus in animal cells. If further work shows that this is in truth the case, interesting and new opportunities for experimental study will be opened up of a kind essentially different from those contingent upon the discovery of the nucleus.

To come back to the starting point in our discussion of what we are pleased to call "cellular organization" which is, after all, the central problem of physiology, it is as if an inhabitant of Mars observed one of our large manufacturing plants with a powerful telescope and discovered a large and conspicuous building, and, further, that he noted similar buildings in other centers the world over, capable of changes in size and shape and of migration from place to place. It would be only natural for him to try to discover what mysterious activities go on within them. This is what we are endeavoring to do with the Golgi apparatus in animal cells. At present we see through a glass darkly, but we hope that this haziness is merely the rather invigorating cloud of mystery which usually surrounds a new development in science. We do not like to think that we are only hot in the pursuit of a phantom.

E. V. COWDRY
THE ROCKEFELLER INSTITUTE FOR MEDICAL RESEARCH
NEW YORK

THE NEW PEABODY MUSEUM AT YALE UNIVERSITY

THE corner-stone of the new Peabody Museum at Yale University was laid on June 18. President Angell presided, and Professor Edward S. Dana, Yale '70, chairman of the museum trustees, and curator of the mineralogical collection since 1874, laid the corner-stone. Professor Richard S. Lull, director of the museum and curator of vertebrate paleontology, spoke of the present work and future plans of the museum staff. Professor Dana referred to the fact that seven years had elapsed since the trustees agreed to surrender the old museum site in order to make possible the erection of the Memorial Quadrangle. The former Peabody Museum, opened in 1876, cost about $175,-000; the new building will cost about $900,000.

Our chief duty and pleasure to-day, said Mr. Dana, is to honor the generous gentlemen who gave the original sum for our Museum of Natural History, Mr. George Peabody; also Professor Othniel C. Marsh, who collected and studied the specimens which make our collections unique; also the many other gentlemen who have worked loyally with him and since his death.

Mr. Peabody, born in Danvers, Massachusetts, in 1795, a poor boy at the start, by his own efforts and sagacity amassed a large fortune, and of this he gave away about ten million dollars before his death in 1869—an enormous sum for that time. His gifts were so numerous that no attempt can be made to enumerate them here. First in magnitude and importance was the gift of one and three quarter millions for the housing of the poor of London. This generous act was so fully appreciated in England, where Mr. Peabody spent the larger part of his life, that Queen Victoria warmly acknowledged it, and presented Mr. Peabody with a miniature of herself surrounded by diamonds and pearls. But this was only one of Mr. Peabody's generous donations. To the city of Baltimore he gave one million dollars; to the South he gave two millions and a half to assist in popular education without distinction of race or color; to many other cities and institutions he gave also most liberally. The gifts, however, which concern us to-day are those of one hundred and fifty thousand dollars each to Yale for a Museum of Natural History, and to Harvard for a Museum of American Archeology.

The Peabody Museum will always be associated with the name of Professor Othniel Charles Marsh. Not only was the fact of his being a nephew of Mr. Peabody, an important element in our securing the gift mentioned of $150,000, but by his keen scientific knowledge and by his collecting, begun even before his first expedition with students of the College in 1870, he amassed an amount of material in vertebrate paleontology that is absolutely unique. In the early years the West was an unexplored region, the localities where the fossil remains existed had never been disturbed, and much of the material had been weathered out by nature entire or in part, so that the minimum amount of labor was required for its collection. Tons of invaluable specimens in thousands of boxes came from the West, and when Professor Marsh died in 1899, the Marsh Collections were of such extent that even now with numerous assistants at work, much of the material is still to be developed. It would be a graceful thing to mention the names of his helpers, but time does not permit. Collecting and study are still going on under the supervision of the director, Professor R. S. Lull, and hardly a month passes that papers are not published on the Marsh collections. This last work is aided by the Marsh Publication Fund, $30,000 and more, left in his will primarily to complete some of the volumes he had begun or had in his mind. This particular use of the money was found to be impracticable, however, be-

cause the volumes were not far enough advanced to make it possible for others to go on with the work except on an independent basis—hence the establishment of this sum as a special fund to be used for the working out and description of the Marsh material. It is indeed fitting that the main hall of the new building in the plans as now matured should be devoted to the exhibition of the more striking of the remarkable extinct animals in the Marsh Collection. Some of them are bizarre in appearance or very large in form. The *Brontosaurus,* for example, of which we have a practically perfect skeleton, measures sixty-seven feet in length. The *Stegosaurus* and *Claosaurus* are other of our gigantic reptiles; they are the relatives of those of the Connecticut River Valley which made the so-called bird tracks of which we also have a very large collection. The work of installing the specimens, begun by Professor Marsh, carried on by Professors Beecher, Schuchert, Lull and others, has been a great enterprise, even now continued under the generous roof of the Osborn Laboratories.

The Zoological Collection is also remarkably complete and fine, especially in the marine life of our Atlantic and Pacific shores. This we owe most of all to the ceaseless labors of Professor A. E. Verrill, also simultaneously of Professor Sydney I. Smith, and recently of Professors W. R. Coe and R. G. Harrison. Professor Verrill's long connection with the work of the United States Fish Commission was invaluable to us. It would require far more time than is available now to give any adequate idea of the labors of Professor Verrill, a student of the great Louis Agassiz in the sixties, and an indefatigable worker from the beginning even to the present time, when he carries a number of years that would crush most men.

The mineral collection, a very prominent part of the treasures in the "Old Cabinet Building" on the Yale College campus, which disappeared long ago, was transferred to the museum in 1876, and has grown steadily since that time till it was packed up and moved. Every specimen was out of the building by May, 1917. This collection, with many additions not yet exhibited, will be installed in this building by the new curator, Professor W. E. Ford.

The archeological collection was also begun by Professor Marsh. It has been added to largely by the present active curator, Professor George Grant MacCurdy. It is now of great value and extent.

Professor Lull spoke in part as follows:

During this period the zoological collections have been carefully inspected, renewed and classified, and many new preparations, both of individual specimens and of habitat groups, have been carried to completion in anticipation of the new halls which they are to grace.

The department of geology, really paleontology, has been yet more active in proportion to its larger staff. About fourteen hundred out of some forty-five hundred trays of fossil vertebrates, containing many thousands of specimens in varying degree of preparation and repair, have passed through the hands of the preparators, and are for the first time entirely conditioned for exhibition, study, systematic storage or exchange. Group after group of creatures thus prepared have been catalogued and monographed, so that, aside from its present accessibility due to our more complete knowledge of its contents, the scientific data which the collection has yielded have been made the subject matter of more than one hundred technical papers, which have appeared or are ready for publication. In addition seven skeletons of pre-historic animals of moderate size have been mounted, some of them embodying original ideas of technique as yet unattempted elsewhere.

The invertebrate collections have been likewise reworked to as large an extent as time and the available labor permitted, and have been also the source of scientific enlightenment to the world. During the disembodied period the collection has increased by purchase, expedition and gift, some of the results of which filled sorely felt gaps in our study and especially our exhibition series. I can mention only the collection of Permian insects—which, excepting Sellard's, probably equally large, is the greatest in the world—gathered by Professor Dunbar; the materials illustrating European pre-history assembled by Professor MacCurdy; the beautiful collection of American Indian relics made by Colonel Charles H. Bigelow and given by Mrs. Bigelow; the Yale Peruvian collection presented through Director Bingham; and lastly, because of its supreme importance, the marvelous collection of the heads and skins of the vanishing great mammals of the world, presented by Mr. Thomas Cardeza.

A year should see the completion of this fabric with its nine halls for exhibition, in which the collections will be most carefully installed in such a way that he who visits them can view the orderliness and continuity of Nature and observe for himself the results of what Henry Van Dyke calls the "Divine Law of Evolution." These halls will be used not alone by Yale students, although as a university museum the chief aim is for their teaching, but the other duty to the city is not lost sight of, for New Haven has no civic museums, save that of the New Haven Colony Historical Society, as have many of the other cities of the world, but relies on the university collections to aid in the dissemination of truth to her people. A direct appeal will be made to the visiting public, but more especially to the young citizens of our public schools.

SCIENTIFIC EVENTS

TRIESTE AND MARINE BIOLOGY

DR. M. STENTA, director of the Natural History Museum in Trieste, delivered an address, in October, 1921, at the Trieste meeting of the Italian Society for the Advancement of Science, on the part played by Trieste in the study of marine biology. The address has recently been published and is abstracted in *Nature*, from which we quote.

Dr. Stenta referred to the observations of Abbot Fortis published in 1771 on the islands of the Quarnero, and those of Abbot Olivi (1792), who gave, in his "Zoologia Adriatica," a catalogue of the animals of the Gulf of Venice. Almost all the naturalists who visited Trieste in the first half of last century were German; of these, two may be named: I. L. C. Gravenhorst, who recorded (1831) the results of his studies on various molluscs, echinoderms and Anthozoa; and J. G. F. Will, who gave an account (1844) of the anatomy of Scyphozoa, ctenophores and siphonophores. K. E. von Baer came in 1845 from Russia to Trieste to search for larvae of echinoderms, but the results in that and in the following year were not very satisfactory. His visit, however, was fruitful in another respect, for he encouraged Koch, a young Swiss merchant resident in Trieste and an ardent collector, in his project of founding a museum of the Adriatic fauna, which became the center of studies on the Gulf of Venice. Johannes Müller spent the autumn of 1850 in Trieste working on the development of echinoderms and worms.

Among many who worked at the museum between 1850 and 1870 were Oscar Schmidt, who carried on researches on sponges; A. E. Grube, who examined the annelids and discovered the parasitic rotifer *Seison nebaliae*; and Kowalevsky, who described (1868) the remarkable sexual dimorphism in *Bonellia viridis*. In 1874 the Adriatic Society of Natural Science was founded and the 27 volumes of its bulletin are rich in observations on the biology of the area.

In 1875 the Institute of Marine Biology was established by the Austrian Government, and many famous naturalists have worked in its laboratories, *e.g.*, Metchnikoff, on intracellular digestion and phagocytosis; Kowalevsky, on medusae; Driesch, on the development of isolated blastomeres; the brothers Hertwig, F. E. Schultze, K. Grobben and Hatschek.

In 1900 the zoological station was enlarged and reorganized under the new director, Professor C. I. Cori. A list of the more important investigations carried on at the laboratory from that time until 1915 is given by Dr. Stenta, including Friedländer's investigation of the constitution of the purple secretion of Murex, for which 14,000 specimens were collected; Heider's work on the development of Balanoglossus, and Przibram's researches on regeneration in Crustacea. There were also several investigations in applied zoology; the culture of sponges, the coral fishery, and parasitic protozoa of fishes.

It appears from the concluding part of the address that the Italian Royal Committee for Marine Investigation, which took over the zoological stations at Trieste and Rovigno, proposes to suppress the former, and Dr. Stenta puts forward a plea for its retention.

LIVERPOOL MEETING OF THE BRITISH ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE

A PRELIMINARY program of the Liverpool meeting of the British Association, to be held from September 12 to 19, under the presidency of Sir Ernest Rutherford, has been issued. The railway companies have agreed to supply return tickets at a single fare and a third to all members who obtain vouchers from the offices of the association, at Burlington House. The president is to deliver his address at the opening meeting on the first evening, taking as his subject the "Electrical Structure of Matter." He will probably be able to describe recent work in the experimental transmutation of elements.

In accordance with the innovation made since the war, the thirteen addresses of the sectional presidents are to be distributed over the week, five being given on the Thursday, five on Friday, and three on Monday. In these the applied side of science is to be given full scope, Professor Ashworth discussing the bearing of zoology on human welfare; Dr. Vaughan Cornish, the opportunity of the British Empire; Dr. Crowther, science and the agricultural crisis; Sir H. Fowler, science and transport; Mr. C. Burt, the mental differences of individuals with special reference to industry; and Sir William Beveridge, employment and population. The presidents of the geological, physiological, botanical, chemical and mathematical sections are to deal with pure science. Professor Nunn is to discuss the education of the masses, and Professor Newberry is to devote his address to Egypt as a field for anthropological research.

The two most important discussions are to be held by the physicists, chemists and engineers on cohesion and molecular forces, and by the chemists and physiologists on the physical chemistry of membranes and its relation to human physiology. There will be a discussion on the origin of domestic animals by geographers and anthropologists.

The Lord Mayor of Liverpool is to give a reception on the Thursday evening, on Friday evening Professor Elliot Smith is to lecture on the study of man, and on the Tuesday evening there is to be a scientific soirée. The more important industrial works in or near Liverpool are to give opportunities to members

to inspect them and excursions of a varied nature are being arranged.

THE OPTICAL SOCIETY OF AMERICA

THE Eighth Annual Meeting of the Optical Society of America will be held at Cleveland, Ohio, October 25, 26 and 27, 1923. The regular sessions for the reading of papers will be open to all interested persons.

Members and others desiring to communicate results of optical research are invited to submit titles of papers for the program to the secretary any time before September 10. Titles received after that date can not be included in the program. There will be no "supplementary program." Each title must be accompanied by an abstract ready for publication. These abstracts will be printed in the program and in the minutes of the meeting. The purpose of the abstract is to give: (1) A more definite description of the *nature* and *scope* of the paper than can be conveyed in the title; (2) the essential results in so far as may be possible in the limited space allowed. It is hoped that the advance publication of these abstracts will prepare those attending the meeting to consider the papers more intelligently and with much greater interest. Printed forms on which to submit titles and abstracts may be obtained on application to the secretary. Inasmuch as their use will greatly simplify and expedite the work of editing and printing the program, the secretary earnestly requests that these forms be used in submitting abstracts.

Attention is invited to the following resolution adopted by the council at its annual meeting, October, 1922: "That it is the sense of the council that ordinarily members should not present, without invitation, papers which have already been published."

No title will be printed to be presented "by title." Titles should not be submitted unless the author has a *bona fide* intention to actually present the paper orally or have it presented by some one else.

The Committee on Papers for the Cleveland Meeting consists of Herbert E. Ives, *Chairman*, W. E. Forsythe, H. G. Gale, Irwin G. Priest and Charles Sheard.

IRWIN G. PRIEST,
Secretary.

BUREAU OF STANDARDS,
WASHINGTON, D. C.

THE ROCKEFELLER INSTITUTE FOR MEDICAL RESEARCH

THE Board of Scientific Directors of The Rockefeller Institute for Medical Research announces the following promotions and appointments:

Dr. Oswald T. Avery, Dr. Walter A. Jacobs, Dr. Michael Heidelberger, Dr. Christen Lundsgaard, Dr. Peter K. Olitsky and Dr. Louise Pearce, hitherto associates have been made associate members. Dr. David I. Hitchcock, Dr. Frederic M. Nicholson, Dr. Henry S. Simms and Dr. Leslie T. Webster, hitherto assistants have been made associates. Dr. Mimosa H. Pfaltz, hitherto a fellow, has been made an assistant.

The following new appointments are announced:

Associate Members	Dr. Jacob J. Bronfenbrenner
	Dr. Paul A. Lewis
Associates	Dr. Oskar Baudisch
	Mr. Herbert L. J. Haller
	Dr. Stuart Mudd
Assistants	Mr. Arnold M. Collins
	Dr. John H. Crawford
	Dr. Robert Elman
	Dr. Joseph H. B. Grant
	Mr. Moses Kunitz
	Dr. Cecil D. Murray
	Dr. Everett S. Sanderson
	Dr. David T. Smith
	Mr. James Vander Scheer
	Dr. Lars A. Welo
Fellows	Miss Gladys Bryant
	Dr. Charles Korb
	Miss Dorothy Loomis
	Dr. Elmer L. Straub

Dr. J. Howard Brown, hitherto an associate in the department of animal pathology, has accepted a position as associate professor of bacteriology with Johns Hopkins Medical School.

Dr. Fred A. Taylor, hitherto an associate in chemistry, has accepted a position as head of the department of bio-chemistry at the William H. Singer Memorial Research Laboratory, Pittsburgh, Pa.

HONORARY DEGREES AT YALE UNIVERSITY

IN presenting candidates for honorary degrees at Yale University, Professor William Lyon Phelps said of those on whom the doctorate of science were conferred:

WALTER BRADFORD CANNON: Physiologist. Dr. Cannon was born in Wisconsin, is a graduate of Harvard and professor of physiology. He is a fellow of many scientific societies at home and abroad. His war services were conspicuous. He was president of the Medical Research Society of the American Red Cross in France in 1917–18, and lieutenant-colonel of the Medical Corps. He was decorated Companion of the Bath, British, in 1919. As an investigator he is in the front rank of American physiologists. His work on organic conditions as affected by emotion is profoundly original, and on it is based the diagnostic method which is now employed. When he was a medical student in 1896, he used the X-ray while studying the processes of digestion. He observed that anxiety, worry and anger were immediately registered by the stoppage of motions in the alimentary tract. He became a specialist in the relation of emo-

tional excitement to bodily disorders and has since given us scientific reasons for not worrying and for remaining cool under provocation. For nearly two years, 1917–1919, Dr. Cannon was working in France on the results of shock, and in the perfecting of the proper treatment. He is a scholar and a benefactor of mankind.

JACQUES LOEB: Head of the Department of Experimental Biology, Rockefeller Institute for Medical Research. Dr. Loeb was born in Germany, and studied medicine at Berlin and Munich, receiving the degree of doctor of medicine from Strasbourg in 1884. He is a member of many learned societies at home and abroad: The National Academy of Sciences; honorary member of the Royal Institute, corresponding member of the Institute of France, honorary member Royal Belgian Medical Academy, corresponding member Cracow Academy, the Moscow Society of Naturalists. He has been professor at Bryn Mawr, for the eagle eye of Miss Carey Thomas saw his youthful possibilities; at Chicago and at the University of California. Since 1910 he has been head of the division of general physiology, Rockefeller Institute. His publications have made him one of the foremost men of science in the world. His work on artificial parthenogenesis is nothing short of epoch-making, and his analyses of the mechanical and chemical bases of the simpler forms of animal behavior bid fair to revolutionize the fundamental conceptions of biology. An experimenter of extraordinary ingenuity, he has brought all the resources of physics and chemistry to bear on the interpretation of vital processes. His work on the dynamics of living matter has led him to profound discussions upon mechanistic philosophy. He is something more than an original investigator; he is, in every sense of the word, creative.

HENRY FAIRFIELD OSBORN: Paleontologist. Merely to enumerate the list of Dr. Osborn's achievements, services, and resulting decorations would make us late for the alumni dinner. He was graduated from Princeton in 1877: he has received the degree of doctor of science from Princeton and from Cambridge; doctor of philosophy from Christiania, and doctor of laws from Trinity, Princeton and Columbia. He was professor of comparative anatomy at Princeton, professor of biology and later research professor of zoology at Columbia, where for some years he was dean of the faculty of pure science. He is president of the American Museum of Natural History, easily the first institution of its kind in this country and undoubtedly in the front ranks of the world's great museums. He has also been president of innumerable institutions and societies in natural history, vertebrate paleontology and zoology. The range of his activities may be partly indicated by his having been president of the International Congress of Eugenics, of the American Bison Society and of a School for Girls. He is an honorary member of scientific societies in England, France, Russia, Germany, Italy, Sweden, Belgium and South America. He is not only a citizen of the world, but of all time, applying the most recent methods of study to the most ancient periods of history. His books are illuminating illustrations of the happy combination of scientific information and literary art.

JOSEPH LEIDY COMMEMORATIVE MEETING

ON December 6, 1923, the centenary of the birth of Dr. Joseph Leidy will be commemorated by several meetings to be held in the Academy of Natural Sciences of Philadelphia. The meetings will be under the auspices of the following organizations, with all of which Dr. Leidy was associated:

The Academy of Natural Sciences of Philadelphia
The American Association of Anatomists
The American Entomological Society
The American Philosophical Society
The American Society of Naturalists
The Boston Society of Natural History
The College of Physicians of Philadelphia
The National Academy of Sciences
The Smithsonian Institution
The Swarthmore College
The University of Pennsylvania
The Wagner Free Institute of Science
The Wistar Institute of Anatomy and Biology
The Zoological Society of Philadelphia

A large number of scientific organizations throughout the world have been invited to designate representatives to attend the meetings, which have been planned to suitably present the comprehensiveness of Dr. Leidy's researches.

The addresses to be delivered at the meetings will be appreciative of the diversity of Dr. Leidy's contributions to science. These have been selected as follows: General estimate of influence upon scientific thought and development; Personal recollections and appreciation as an anatomist; Zoological work; Paleontological and geological work; Botanical work; Mineralogical work; Medical work. The speakers upon these topics have been selected and their names will be announced at a later date.

As a part of the commemorative meeting there will be established a Joseph Leidy Memorial Medal, as a trust with the Academy of Natural Sciences of Philadelphia, to be awarded in recognition of preeminent contributions to the biological sciences.

A banquet at the time of the meeting has been planned, and several other features, which would aid in suitably and permanently commemorating the importance of Dr. Leidy's researches, may be arranged.

The joint committee in charge of the commemoration is composed of twenty-one representatives of the above listed organizations. An executive subcommittee of ten has immediate direction of details for the main committee. The address of the committee and executive sub-committee is, care of the Academy of Natural Sciences of Philadelphia.

SCIENTIFIC NOTES AND NEWS

SCIENCE will hereafter be printed by The Science Press Printing Company, Lancaster, Pennsylvania.

Dr. David White, senior geologist of the United States Geological Survey and president of the Geological Society of America, received the degree of doctor of science from the University of Cincinnati on June 16, and the same degree from the University of Rochester on June 18.

Brown University has conferred its doctorate of science on Dr. George D. Birkhoff, professor of mathematics in Harvard University.

The degree of doctor of science has been conferred by Williams College on Edward Barton, professor of sanitary chemistry at the University of Illinois.

William Boyce Thompson, of New York, president of the Roosevelt Memorial Association, who recently founded the Institute for Plant Research at Yonkers, N. Y., received the degree of doctor of laws at the commencement exercises of the University of Kentucky.

The University of Cambridge has conferred the doctorate of science on Professor H. A. Lorentz, of Leiden, who has been lecturing in England under the auspices of the Anglo-Batavian Society.

The University of St. Andrews will confer the honorary degree of LL.D. on Herbert William Richmond, University lecturer in mathematics in the University of Cambridge, retiring president of the London Mathematical Society, and Sir Robert Robertson, chief government chemist, London.

On the occasion of the birthday of the King of England the following have been knighted: G. H. Knibbs, director of the Bureau of Science and Industry, of Australia; W. J. R. Simpson, professor of hygiene, King's College, London; Dr. H. W. G. Mackenzie, Royal College of Physicians, and J. Evershed, director of the Kodaikanal and Madras Observatories.

M. Molliard, dean of the faculty of science of the University of Paris, has been elected a member of the Paris Academy of Sciences in the section of botany to succeed the late Gaston Bonnier.

The Helmholtz gold medal, awarded once in ten years by an international committee for the most significant research in the domain of optics, has been given to Professor K. von Hess, of Munich, for his investigations on color vision.

The Swedish Medical Association has founded a gold medal, called the "Gullstrand Medal," in honor of Dr. Alvar Gullstrand, professor in physiologic and physical optics at Upsala. This prize will be awarded for the first time in 1932 and thereafter each tenth year, without regard to nationality.

Dr. G. N. Lewis, of the University of California, has been elected an honorary member of the London Chemical Society.

Professor Jacob G. Lipman, of Rutgers College, has been elected a member of the Swedish Royal Society of Agriculture.

At the recent meeting in Montreal of the Canadian Medical Association a resolution of thanks was passed to Dr. T. C. Banting, of Toronto, for the discovery of insulin. It was announced that the Canadian Government would be asked to offer suitable recognition of Dr. Banting's services.

A farewell banquet was tendered Dr. Perry G. Snow, retiring dean of the University of Utah School of Medicine, by the students of the medical association of the university on May 24. Professor L. L. Daines acted as toastmaster. Dr. Snow, who will be succeeded as dean by Dr. Ralph O. Porter, of Logan, Utah, will make a tour of the eastern medical schools.

The silver loving cup, given by the Detroit Local Section of The American Society of Mechanical Engineers to the Associated Technical Societies of Detroit to be presented to the winner of the civic welfare papers contest, was won by Frank Burton, commissioner of buildings and safety engineering for the city of Detroit. The prize-winning paper was on "*The fundamentals of city zoning.*"

George A. Stetson, assistant professor of mechanical engineering at Yale University, and for the past four years editor of the *Transactions* of The American Society of Mechanical Engineers, has resigned both these positions to enter the wholesale coal business in Boston.

Dr. Herman M. Biggs, New York State commissioner of health, formerly professor of medicine in the University and Bellevue Hospital Medical School, died on June 28, of pneumonia, at the age of sixty-three.

UNIVERSITY AND EDUCATIONAL NOTES

The University of Chicago has announced a gift of $200,000 from the Seymour Coman estate, the income to be used for "scientific research, with special reference to preventive medicine and the cause, prevention and cure of diseases."

At the commencement exercises of Rensselaer Polytechnic Institute last week, the alumni association made initial plans for the celebration in October, 1924, of the centennial of the institute.

Herbert S. Hadley, formerly governor of Missouri, has been elected president of the University of Missouri, to succeed Dr. Frederic A. Hall.

MR. CHARLES W. PUGSLEY, of Lincoln, Nebraska, assistant secretary of agriculture, has presented his resignation to Secretary Wallace and has accepted the presidency of the South Dakota College of Agriculture and Mechanical Arts.

DR. J. HOWARD BROWN, Europa, Miss., and Dr. William L. Holman, San Francisco, have been appointed associate professors in bacteriology at Johns Hopkins Medical School, to succeed Dr. Stanhope Bayne-Jones, who resigned to become head of the department of bacteriology in the University of Rochester Medical School.

DISCUSSION AND CORRESPONDENCE

ON THE DONNAN EQUILIBRIUM AND THE EQUATION OF GIBBS

THE theory of membrane equilibrium due to F. Donnan (1911) is exciting much attention at the present time. There is no doubt that it is one of the most important contributions to colloid chemistry, and as the work of a fellow countryman, I do not wish to diminish the praise that has been given to it. Nevertheless, it is of historical interest to find that the Donnan equilibrium is one more addition to the list of theories implicit in the work of J. Willard Gibbs, published in the transactions of the Connecticut Academy in 1875. It is remarkable that Gibbs' equation has been overlooked for more than forty years, in view of the fact that membrane equilibrium enters into so many problems.

The following quotation is taken from the 1906 edition of "The Scientific Papers of J. Willard Gibbs," Vol. 1, p. 83:

We will, however, observe that if the components S_1, S_2, etc., can pass the diaphragm simultaneously in the proportions a_1, a_2, we shall have for one particular condition of equilibrium

$$a_1m_1' + a_2m_2' + \text{etc.}, = a_1m_1'' + a_2m_2'' + \text{etc.} \ldots\text{"} \quad (78)$$

a_1 = equivalent weight of substance S_1

a_2 = equivalent weight of substance S_2

$m_1' = m_2'$ are the potentials of S_1, S_2 inside the membrane

$m_1' = m_2''$ are the potentials of S_1, S_2 outside the membrane

If S_1, S_2 behave like perfect gases, equation (78) can be simplified since $dm_1 =$ at. d. log p_1 (285) where t is the temperature and p the pressure

$$\log p_1 + \log p_2'' = \log p_1'' + \log p_2''$$

expressing concentrations in the conventional manner this becomes

$$[S_1]' \times [S_2]'' = [S_1]'' \times [S_2]''$$

Equation (78) applies to solutions of electrolytes which do not obey the gas laws, but we have stated this simple form of it for comparison with Donnan's equation:

$$[Na]' \times [Cl]' = [Na]'' \times [Cl]''$$

G. S. ADAIR

MASSACHUSETTS GENERAL HOSPITAL
BOSTON, MASSACHUSETTS

IRON-DEPOSITING BACTERIA

THE presence of three kinds of iron-depositing bacteria (*Spirophyllum ferrugineum* Ellis, *Gallionella ferruginea* Ehrenburg, *Leptothrix ochracea* Kützing or *Chlamydothrix ochracea* Migula) in the natural chalybeate waters around Yellow Springs, Ohio, seems not to have been reported previously.

Gallionella, according to Harder,[1] has been reported in three localities in the United States, *viz.*, from mines in southwestern Wisconsin, central Minnesota and from the city water supply of Madison, Wisconsin. As found at Yellow Springs, Gallionella, as well as the other two genera mentioned above, is abundant in the water that issues to the surface in the Cedarville limestone. One of these chalybeate springs has made a large deposit of ocherous material, which gives us some indication that the deposition at this particular spring has probably been going on for a long time.

As noted by Harder[1] it is quite striking that these iron bacteria are so peculiarly distributed, their distribution sometimes seeming to depend upon the amount of iron in the water, but often on other less well-known causes. We have many springs in this vicinity and these bacteria appear in a very few of them. The causes of distribution as well as many morphological and physiological features of these iron-depositing bacteria remain unsettled.

O. L. INMAN

ANTIOCH COLLEGE

WATER GLASS AS A MOUNTING MEDIUM

THE use of the common water glass or egg preserver as a mounting medium for microscopic objects has not been reported to my knowledge. Very recently I have had occasion to use it with such apparently successful results that I am forwarding this note in the hope that others who possibly have tried it successfully or otherwise will give us the benefit of their experiences.

It is used in the same manner that one would employ with Canada balsam, but has the added advantage that dehydration is not necessary. The medium at the periphery of the cover glass quickly hardens to the consistency of glass itself, thus sealing in the liquid center in which the specimen is held. The liquid condition of the medium surrounding the specimen, while viscous enough to prevent movement,

[1] Harder, E. C., "Iron-depositing bacteria and their geologic relations," U. S. Geological Survey Professional Paper 113.

allows hairs, scales and bristles to maintain a natural position. It is not satisfactory for mounting alcoholic specimens, but those previously cleared in K O H may be mounted with the same ease that is experienced with fresh or water preparations.

It also makes a very satisfactory substitute for shellac in mounting insects on points, as it is colorless, unaffected by heat and holds the insect securely in many cases where the shellac mounted insect is apt to snap off.

DEAN T. BURK
UNIVERSITY OF CALIFORNIA

STAFF ORGANIZATION OF INSTITUTIONS OF RESEARCH AND EDUCATION

PROFESSOR WHETZEL'S letter of resignation as administrative head of the Department of Plant Pathology at Cornell University, extracts from which were printed in *Phytopathology,* xii 10, October, 1922, p. 499, ought to lead to a broad discussion of the staff organization of our institutions of research and education. There is no question that our present system is archaic, a remnant of the time when our institutions were small and each department was fully served by a single scientist or professor with perhaps the aid of an assistant whose duties were strictly those of a helper.

With the growth of our institutions there has been a natural increase in the working force of the various departments, while administrative duties have absorbed more and more of the energies of the department chief, with the result that at the present time the bulk of the research and teaching is being taken care of by persons of the nominal grade of assistant, though with a minimum of direct supervision by the department head. If the only persons concerned were those to whom the system is familiar, the matter of title would be of little consequence. The system, however, is very confusing to members of the general public, who are in the habit of interpreting the titles of professional workers in terms of their own occupation. To such persons the assistant is merely a helper, a species of apprentice who has not demonstrated the capacity for independent work, and one who remains an assistant indefinitely is looked upon as a failure in his profession. Not long ago I was discussing the merits of a certain research worker with a man of wide business experience when I was interrupted by the remark: "But he is only an assistant. He hasn't arrived." Need we marvel that men of this type are so often suspicious of the education which has been so largely imparted by the assistant professors of our colleges? Is it strange that the hard-headed business men who inhabit our legislative halls go slow in providing support for research to be carried on by apprentices? And how are we to regard the farmer who, having written for information to his state experiment station and receiving a perfectly good letter signed by an assistant, feels that his request has been slighted, loses confidence in the institution and fails to write again?

Thus it follows that young men of real ability as teachers or investigators, if they are to gain proper recognition and an adequate salary, and if they are to gratify a laudable ambition for accomplishment, are forced into commercial lines or obliged to seek administrative positions when they may have but moderate administrative talent and would be happier and more successful could they pursue the occupation of their choice. As the demand for administrators is limited, the result is discontent and frequent changes of personnel. Evidently there is a feeling abroad that the present form of organization might be improved. Many of the larger universities have established full professorships other than those occupied by administrative department heads, but this practice does not abound to as great an extent as could be wished. The appointment of associates and subsidiary research men has served as an expedient to get around the difficulty. No doubt many of the heads of our institutions would be glad to give their men greater recognition if they could do so without appearing to degrade the professional title by associating it with an inadequate salary, and there are certainly numerous departmental heads of broad enough mind to see no loss of prestige to themselves in an increased recognition of their associates. Probably reforms in these respects may best be brought about by degrees, and Professor Whetzel's suggestions, if not too strictly interpreted, have a good deal of point as a step taken by one on the inside. May we not hope that when many of the so-called assistants shall find themselves in positions of administrative authority, means may be found for further progress in organization reform?

W. J. YOUNG
OHIO AGRICULTURAL EXPERIMENT STATION

QUOTATIONS

THE BRITISH NATIONAL TRUST

YESTERDAY the National Trust added another interesting possession to its steadily growing list. Lord Ullswater accepted, on its behalf, from the Norfolk and Norwich Naturalists' Society an island of some twelve hundred acres of sand-dunes and saltings on the Norfolk coast, the protection of which has long been desired by all lovers of birds and flowers to whom it was known. Such a place finds its natural guardian in the Trust, whose work at Wicken Fen, Blakeney Point, and elsewhere has already won the

confidence of those who are alive to the importance of saving our Nature reserves before it is too late. The task of protecting such properties from the dangers which threaten them is not an easy one, even after they have been acquired, as was hinted in the account of Scolt Head given in our columns on Thursday. But the first step is their purchase, and it is satisfactory that that step has again been successfully taken and another home of wild life added to the secured treasures of the nation.

Few societies have gone more steadily forward, even during the last nine difficult years, than the National Trust. It is not yet thirty years old, but in a very short time it won such public confidence that it received special powers under its own Act of Parliament; and it has now more than a hundred properties of one kind or another. What is more remarkable is that nearly half of them have been acquired during the lean years which have followed 1913. Of course a hundred is a mere drop in the ocean of "places of natural beauty or historic interest" which it would be desirable to see in the hands of the Trust. But it is a beginning, and a beginning which has grown fast, and promises to grow still faster. The truth is that the growth of the Trust is partly the result and partly the cause of a change in public opinion. A hundred, and even fifty, years ago buildings of the greatest historic or architectural interest were destroyed, places of exceptional beauty were built over or otherwise ruined, and scarcely a voice was heard in protest. Such crimes, or follies, are still committed, though much less often; but now they never fail to arouse public indignation. The whole movement demanding the preservation of great architecture and the protection of beautiful landscape has gathered greatly increased force since the foundation of the Trust. The original Ancient Monuments Act has been largely extended: a permanent Commission on Historical Monuments has been appointed, and has already published its survey of several counties; a Society for Nature Reserves has been founded; many dioceses have established committees for the care of their churches; and the National Trust itself has become the owner of one or two large and many small historic houses, several properties having associations with such great names as those of Gray and Wolfe and Coleridge, and some thousands of acres of the most beautiful open land in the country, including a large part of the shore of Derwentwater and other properties adjoining Ullswater and Windermere. Such achievements are proof of the strength of the movement and a sure promise of its future development. *Vires acquirit eundo.* What is done to-day will be doubled to-morrow. But the need is doubling, too. Time and man are always engaged in the work of destruction, and an always increasing population is always needing more open spaces. However fast the Trust grows, it is certain that it will not, at least in our time, overtake the calls made upon it.—*The London Times.*

SCIENTIFIC BOOKS

A History of Magic and Experimental Science during the First Thirteen Centuries of our Era. By Lynn Thorndike, Ph.D., professor of history in Western Reserve University. Two volumes, I. xl. 835, II. vi. 1036. New York, The Macmillan Company. 1923.

Professor Thorndike's book of two volumes and more than 1800 pages will easily take the lead of all that has been said of the intellectual conditions of the period of which it treats. It stretches across the centuries from the time of Pliny and Galen to the time of Dante. This is a period of depression in the history of thought in its various phases, of which several writers in this country have studied the details in notable works. To those few still active who in their younger days may have entered the subject through the fascinating pages of Draper's "Intellectual Development of Europe" and are still attracted by the subject, this product of Thorndike's labor will be especially of interest as exhibiting the steps forward in scholarship and in the energy and enterprise of research which it exhibits. The work of Lea on the activity of the "Inquisition in the Middle Ages" and the more recent one of Taylor on the "Medieval Mind" are treasure houses, somewhat dreary, it must be confessed, for the future student, but this book of Thorndike's, for fullness and completeness of reference, for excellence in presentation, for thoroughness of scholarship, leads them all. The reviewer is not familiar with any recent works in this field in foreign languages which can be compared with it. The preface reveals in outline the vast labor undergone, as intimated by the author, and the diligent reader on finishing it will find the author has not exaggerated it, indeed his modesty has not done justice to it in his own account.

In a subject so dull, even so repellent to many readers, he has labored to relieve the tedium of perusal by many touches of humor, but there might well have been more of them, for the record is a long and tiresome one—a record of the imbecility of the human mind at its worst since it has found a method of perpetuating its workings in cursive script. An essay on some aspect of the subject of magic may be made attractive by picking out the high points which allure, but to write an exhaustive and at the same time an attractive compendium of it is another matter. To combine with it an exposition of the springs of what we call experimental science makes it a task

calling for the strength of a Hercules and the omniscience of Jove. In fact the history of experimental science in this connection does not stand forth as it should if Dr. Thorndike were a demigod. In the matter of the exposition of medieval magic the book leaves little to be desired, but for the exposition of the sources of experimental science one must look elsewhere in some future compendium that goes far back of Galen. Such a work should expose more fully the experimental side of Galen's activities. His work on the arteries, but for the impediment of his theories, should have led to a very much better comprehension of the circulation of the blood long before Harvey. His experiments on the spinal nerves and the utilization of the vivisection of apes for the purpose might well have crowded out of Dr. Thorndike's book some of Pliny's drivel. In beginning magic with Pliny the author does not perhaps go far wrong, but experimental science does not begin with Galen nor with the school at Alexandria either, for that matter. Pliny's primitive magic, it is true, was probably already old in the world, and in written history there seems little to cavil at if a start is made with his Natural History, but not so as to experimental science beginning with Galen. This the author very explicitly admits and pleads very justifiably the law of limitations. Nevertheless, one must beware of thinking of magic and experimental science with its start at Pliny and Galen as one involuntarily does in this exposition of them.

It is natural to find Professor Thorndike in difficulties with definitions. "Let a woman spit three times in a frog's mouth and she will not conceive for a year," or, to choose again, this time an example of a technique difficult or impossible to perform, which is a notorious trick with magicians, Saint Hildegarde said, to get a really serviceable amulet you must catch a poisonous snake after he has skinned himself in a cleft of the rock and dry him for the purpose. There is no difficulty in defining these things as magic, but when we come to astronomy arising out of the hokuspokus of astrology, a thing which the author seems unduly to deprecate, or of chemistry out of the supercheries of alchemy, we are on different ground and do not know which to call these activities of medieval monks, magic or experimental science. Now we don't have that trouble when we read Hippocrates or Aristotle; we have to go back to Empedocles for that. With him he must have begun if he was to justify his title as to experimental science. He must have led us up the crest of the wave to the pinnacle of the glory of Greece and down again to the trough of the sea with Pliny and Sextus Empiricus, but even back of them lies a magic, Babylon and Egypt and the Zend Avesta and the Rig Veda and the Poem of Gilgamesh. Now Professor Thorndike realizes all this and there can be no criticism for his curtailment of the subject, but he should have left "experimental science" out of his title if he was going to begin with Galen and give us so little of it even with him.

There are certain defects perhaps unavoidable in thus breaking arbitrarily into the full current of the evolution of thought in the domain of magic and science, admitted though the necessity must be for curtailment. The man-eating ants who mined gold for Prester John and the emetic recommended once a week in the Secret of Secrets of the Pseudo-Aristotle, Hildegarde's boiling of swamp water for drinking purpose, as Cyrus did for the waters of the Choaspes, might all have been found in Herodotus. Even the mistake about respiration of goats through their ears is found in the fragments of Alcmaeon long before Herodotus. Spitting magic came straight out of Egyptian papyri from the primitive magic back of them. The magic of numbers goes back of Pythagoras and is found in far lands which knew naught of any intellectual matters in medieval Europe. Belief in the gods did not antedate magic, but that is a matter of definition again into which we can not go. The Virgil of our modern editions of the Georgics II says nothing at line 480 of gems or herbs or of the minds and wrath of brutes, of fruits or reptiles. Hugh of St. Victor gives quite another hue to the color of line 479 by finding them in his edition, quite a magical atmosphere, which in reality Virgil did not breathe so copiously as the middle ages would make us believe. Comment on this is unfortunately lacking in Professor Thorndike's account. Perhaps he hardly meant to attribute to Galen Alcmaeon's theory of the wave nature of sound, but so the reviewer reads it in the text. The story of Galen catching the lady in love with a play actor is the exact counterpart of a story attributed to Hippocrates in the malady of Prince Perdiccas and more plausibly the same story was told of Erasistratus, because in his time all Alexandria was agog with interest over Herophilus and his work on the pulse. If he had started at the beginning of experimental science with the Greek philosophers, for instance, we would have found the author experimenting in a spurious book of the Hippocratic Corpus with the question of drink passing into the lungs and making a mistake as even scientific experimentalists will do occasionally. As to various other matters relating to the theories of elementary cognition the author might have found a summary in the excellent work of Beare on the subject dealing with work of the predecessors of Aristotle. Whatever Hero of Alexandria may have done in his day, the phenomenon of air pressure on a column of water was adequately demonstrated by Empedocles with his clepsydra. It was primarily on these Adelard of Bath must have based his elaborations. It is interesting,

however, to see the mind of Peter of Abano filled with a hopeless longing for a knowledge of the atomic weights of the elements, but it is not stated if he was guided thereto by Archimedes' celebrated discovery of specific gravity.

Roger Bacon fares badly at the author's hands, one is afraid, because we all in the last twenty years or so have been fed up on Bacon (no pun intended). The guides in Rome irritated the Innocents Abroad by all but ascribing the creation of the world to Michael Angelo, and we have grown a little sensitive about Roger Bacon being wholly responsible for the creation of experimental science, and Professor Thorndike stands so straight on the subject he seems to the dispassionate reader to lean over backwards a little For any one who has wrestled spiritually as well as physically with the tomes of Albertus Magnus, who seems to be his hero, it would be easy to make the Swabian leviathan somewhat of the same kind of a bore. One is, as it is, tempted to say he owes his fame to longevity and industry

There is a tendency to the repetition of certain phrases, which jars the attentive reader a little, there are some words used which are not to be found in the Century dictionary, some slips, but very few, in proof-reading. Indeed, such minor blemishes are exceptionally scarce for a work so extensive. Some perhaps not so negligible may nevertheless be passed over. It is hardly justifiable to refer further to these comparatively few shortcomings, since there is not more space permitted for an appreciation of the merits of a book which is, on the whole, an ornament to American scholarship.

JONATHAN WRIGHT

SPECIAL ARTICLES

ON THE ADAPTATION OF WHEAT TO GROWTH MEDIA DEFICIENT IN NUTRIENTS

IN the correlation obtained between differences in yield of grain of different varieties of spring wheats and that of their relative earliness of maturation appears a relation that suggests a factor which presumably plays no inconsiderable rôle in the adaptation of variety of wheat (and probably other plants) for maximum grain production from growth media markedly deficient in essential salt elements. Of nine different varieties grown in such a medium, the largest yield of grain, 200 milligrams per culture (average of 20, each containing 5 plants), was produced by the variety that ripened first, and the lowest yield, 46 milligrams per culture, produced by one of the last maturing varieties. The other varieties produced yields of grain that fell between these two limits, and the magnitude of yield generally corresponded with the relative earliness of the variety. Seven weeks elapsed between the time the earliest and latest varieties ripened. There was no correlation between the total dry weights of the different varieties and their comparative earliness. The average dry weight produced per culture was approximately 1.3 grams, regardless of variety.

The plants were grown in tap water, which as a growth medium can be defined as being markedly deficient in essential salt elements. Its osmotic value was equal to approximately 0.12 atmosphere osmotic pressure, with the ions Cl, So_4, Ca and Mg constituting the major portion of the solutes. The grain per culture was that which five plants produced, having available to them only those solutes contained in two quarts of tap water (two quart Mason jars were used as the culture containers) plus that which the seedlings 6–9 cm. high, germinated in tap water, contained when set in culture jars and one-half c.c. of .01 mol. solution of $FeSO_4$ per culture added at the beginning of the experiment. When the plants were six weeks old, from 300 to 500 c.c. of distilled water were added to each jar, this being the only change or addition made to the original two quarts of tap water.

As there was no correlation between differences in yield of grain of the different varieties and that of their relative earliness of maturation when they were grown in fertile soil, the question may be asked as to causes operative to bring about the results obtained when tap water was used as the growth medium. It appears that the tap water had no particular merit per se other than being a growth medium, deficient in nutrients, which enabled that variety of wheat that completed its growth cycle in the shortest period of time (that is, an early wheat) to utilize that small supply of salt elements most efficiently in the production of grain. Granted that the rate of utilization of nutrients for similar processes in these wheats was about the same, and that some of the nutrients were used in such a way during the vegetative growth period of the plants as to preclude their later utilization for the production of grain, then obviously the wheat which has a long-growing period, being a late variety, has less nutrients available for grain production than has an early variety. Whether a variety of wheat is early or late undoubtedly is largely determined by genetic and environmental factors, but the result of these factors—that is, whether the variety is early or late—in no small measure determines to what extent that minimum supply of salt elements in the growth medium can best be utilized for the production of grain.

W. F. GERICKE

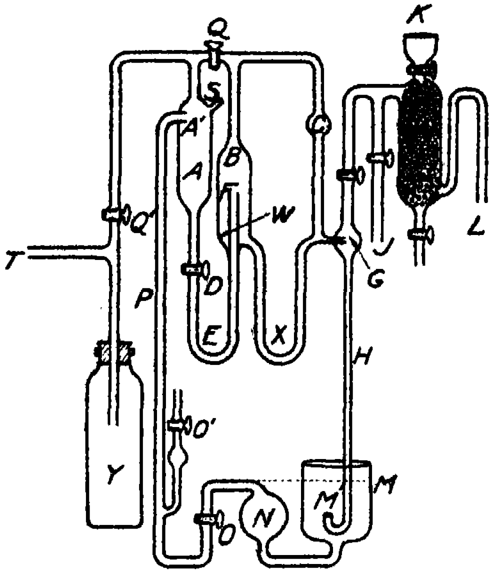
LABORATORY OF PLANT NUTRITION,
UNIVERSITY OF CALIFORNIA

A NEW VACUUM PUMP

IN connection with certain bacterial fermentation studies a new Sprengel pump was designed with three distinct requirements in view: First, to avoid the labor accompanying the raising and lowering of the heavy mercury reservoir of the Sprengel pump; second, to prevent the carrying over of air bubbles from the main mercury reservoir to the falling tube, and third, to make the pump simple, inexpensive and serviceable both for exhaustion and for the collection of gases.

The first difficulty has been overcome successfully by the so-called Boltwood pump, as well as the present device, while the new pump alone meets the other two requirements completely, with the feature of automatic operation retained.

The following description of the new pump and of its operation may be of interest to those who are facing the same problems as the writer's.



A is the main mercury reservoir. Both *B* and *C* bulbs are air traps, *C* being used to insure the complete removal of the air bubbles, should they escape from the trap *B*. One end of the inverted syphon *E* is fused into the air trap *B*, so that the mercury level in *A* and *B* bulbs is always maintained, while the flow of the mercury from *A* to *G* is regulated by the stopcock *D*. *H* is the falling tube, which has a diameter of 2 mm. and a length of 150 mm. A McLeod vacuum gauge *J* is connected to the head of the falling tube *H*, which terminates in one arm of the drying chamber *K*. The fermentation tube *L* is jointed to the other arm of the *K* chamber. *M* is the mercury-reservoir, to collect mercury coming from the falling tube. *N* is the leveling tube whose height must be above that of the inverted end of the falling tube in order to keep it under mercury; especially important during the time of collection of the gases.

The return of the mercury from *M* to *A* is accomplished through the tube *P* with the aid of air admitted at *O′* and mainly by the suction force at *T*, which is connected to a water aspirator. *Y* is a safety bottle used to receive any "kick-back" water from the aspirator. *S* opening at *A* is employed for the filling and emptying of the mercury. It can be sealed up easily by a small rubber stopper. Stopcock *O* is to regulate the flow of the surplus mercury from *N*, and stopcock *O′* to regulate the required amount of air to be admitted to tube *P*.

The pump is operated as follows: Fill the bulb *A* with mercury through the opening *S* up to the level below *A′*. Then open the stopcock *D*, allowing the mercury to flow slowly through *E* over the top of *F*, filling the depression *W*, and then through *X* to *G*. The stopcock *D* should be so regulated that the rapidity of the flow of mercury dropping down from *G* will give the rate needed. When the atmospheric pressure is reduced to about 40 cm., the suction force (aspirator being previously opened) is applied by opening the stopcock *Q′*. At the same time, the stopcocks *O* and *O′* are also regulated, so that the mercury collected in *M* and *H* can be retruned to *A* by the same suction force from *T*. A continuous supply of mercury in the bulb *A* is thus maintained; also, a complete circuit of broken mercury will be seen from *G* to *A* as long as the aspirator is running.

The air bubbles carried over by the mercury from *A* will rise as soon as they emerge from *F*, and will be swept away by the suction force from the aspirator through *Q*. The same process is repeated at *C*. *Q* must be opened very little in order to prevent the suction force from being strong enough to draw the gas from *L* through *G*, instead of being carried down by the mercury drops.

So long as the aspirator is kept in operation, two partial vacuum traps at *B* and *C* are created and maintained, from which the chances for the air bubbles to escape downward are very slight. If they escape at all, the quantity would be so trivial as to cause no serious consequence.

The same pump and the same process of operation are applicable for exhaustion of the culture tube or bottle and for the collection of the bacterial gases. However, when an inverted Hempel burette is used to receive the gas, the mercury level at *M* must be kept at about *M′*. Very little effort is required to manipulate this apparatus when it is once set in operation, provided that the water aspirator has a pressure of 20–25 pounds per square inch, which can always be had in almost every ordinary laboratory.

A minimum atmospheric pressure of about 0.02 mm. has been attained with this apparatus.

C. C. CHEN

THE SHEFFIELD SCIENTIFIC SCHOOL,
YALE UNIVERSITY

SCIENCE

Vol. LVIII JULY 13, 1923 No. 1489

CONTENTS

SCIENCE: A Weekly Journal devoted to the Advancement of Science, edited by J. McKeen Cattell and published every Friday by

THE SCIENCE PRESS

Lancaster, Pa. Garrison, N. Y.

New York City: Grand Central Terminal.

Annual Subscription, $6.00. Single Copies, 15 Cts.

SCIENCE is the official organ of the American Association for the Advancement of Science. Information regarding membership in the association may be secured from the office of the permanent secretary, in the Smithsonian Institution Building, Washington, D. C.

Application made for transfer of entry as second-class matter to the Post Office a Lancaster, Pa.

ON APPLIED AND PURE SCIENCE

THE terms "pure science" and "applied science" are frequently used at the present time, and usually in a manner that logically either does not differentiate between the two terms, or differentiates on the basis of motives of the devotees. The terms "pure" and "applied" are not happy ones, but I shall point out that there is a logical basis upon which a differentiation may be founded. Applied science includes more than what is embraced in the conventional branches of engineering.

It is sometimes intimated that applied science has to do with the selling or salesmanship side of science, whereas pure science is not so commonplace. Sometimes applied science is the practical, pure science the impractical, that is, something more or less associated with the helpless professor who has specialized to an extent that he is very much akin to the suburban ticket agent whose knowledge of time tables, of stations and of railroads is wholly contained upon one card giving the times of departure and arrival of trains at and from his station to the city station.[1] Sometimes pure science is the free or unrestrained as opposed to the applied or restrained. Indeed, some have it that pure science is the more or less useless as compared with the applied, the immediately useful. Or the pure may be the exact in contrast with the applied. At other times the distinction is made on the basis of the motives of the investigator rather than upon the nature or application of the subject-matter. The one then is the altruistic, as opposed to the selfishly commercial. These differentiations on the basis of motives shade off into the strictly intellectual class distinctions, which may even aver that applied science is not a worthy subject for the mind to entertain. This type of attitude was very general in countries outside of Germany up to recent times. It is of interest to remark that it is almost identical with the attitude that prevailed prior to the sixteenth and seventeenth centuries in regard to the experimental sciences in general, as opposed to other activities of the intellect such as the literary, the philosophic or speculative. So far as motives of the investigator are concerned one can find examples in both pure and applied that will illustrate almost any motive that can be entertained by the human mind. An attempt at differentiation on such grounds is futile. We can

[1] Specialization implies a dynamic and not a passive state. It may well be questioned whether either of these cases represents what is meant by specialization.

find in the humblest mechanic's shop that things are very frequently done for their own sake. Some investigators may pride themselves in that they carry on research for its own sake. This is probably true, but it may be equally true for the lawyer, the physician, the blacksmith, the carpenter, the farmer and indeed may be true for all kinds of activities and for all classes of human beings. The feeling of delight in activity of an intellectual kind is a very close kin to the feeling of delight in activity of a purely physical kind. Of course in the former case the attendant circumstances may be far more complex, having more intimate association with ideals, and perhaps at times involved with a more or less artificial standard of sacrifice. If the difference between the pure and the applied science is only one of motive on the part of the investigator, it means that in most cases we shall not be able to tell whether any particular product of research is pure or applied science. For, as the history of science is recorded at the present time, little attention is paid to any personal traits. In fact, it is a matter of common knowledge that the results of science are respected from whatever quarters of the world they come because they are not personal.

Men guard the products of their experimentation and thinking with about the same zealousness as they guard their purses. One may find any mental state activating in the adding to and the use of the purse. So also one may find almost any mental state activating in the adding to or in the use of the intellectual products for monetary returns or for social recognition and power. At the present time scientific research is a professional matter and to classify the products on the grounds of the motive or motives that may have been the governing factor impelling the particular individual to enter any particular profession will lead nowhere. Scientific research, like any other profession or occupation, may be entered into for destructive and even murderous purposes; witness modern wars and preparation for wars;[2] or it may be entered into by an abnormally zealous mind with the idea of sacrifice for the emancipation of mankind. Usually the impulse lies somewhere between these two, and is intimately coupled with the necessity of making a livelihood in a manner most appealing and commendable to the particular individual.

One may expect that if there is a sufficient contrast between the pure and applied for practical differentiation, there must be also a clear basis, other than personal, upon which a practical judgment may be made; or, at least something associated with the personal motive that may be easily discerned by some one not intimate with the investigator himself. There are immediately evident two possibilities; *viz.*, a differentiation upon the nature of the subject-matter itself and the manner of treating it, or upon the uses to which the subject-matter may be or is put. Classes based upon uses of subject-matter may be numerous and are equally trivial. The subject-matter of one branch of science may be said to be applied when used in another branch, whether in the theory or for practical purposes. Again, the uses of the subject-matter in theory may be set in contrast with the uses in practice, as pure and applied. Experimental work might on this basis be called pure or applied science according as it was undertaken for the sake of the theory or for its possibility of usefulness in commerce and industry (*i.e.*, for the sake of its commoditivity). The viewpoint here becomes coincident with that given in detail below based upon a division of the subject-matter rather than upon the uses of the subject-matter.

If the differentiation is on the grounds of the useful and the non-useful, it remains exceedingly difficult to define what may be meant by the word useful. If this word be taken in a very general sense of having the property or capacity of facilitating activity, physical or mental, in any department of human endeavor, then there remains little if any ground upon which to differentiate not only the products of science but those of art and religion as well. If, however, by useful is meant "that which may be immediately applied to net monetary returns," then it might seem to the business man at least that we have a working definition of pure and applied science. But there is no logic in this definition. Some applied science can never net under ordinary circumstances any monetary returns that a bookkeeper may know it. The best that one may hope for is that the aggregate activities over appreciable intervals of time of a laboratory devoted to applied science shall not have been carried at a monetary loss. The interval of time that one may care to consider in this discussion is an important element. If the interval is too short not even applied science can be useful. From the ordinary business viewpoint the interval may be the ordinary business cycle. For larger and more permanent and extensive industrial establishments the interval becomes longer and even indefinite perhaps. No department of science would welcome it, to be stigmatized as useless. There is probably nothing felt more convincingly than that all the present activities that may be classified as scientific will in due time be useful to mankind at large, and will amply redound in actual material wealth and well-being. The aim of science (perhaps in conjunction with other activities ultimately, too) is the conquest of the universe. This has been the theme of the dreams of master minds

[2] This is instanced because it has professional and social recognition. I am not referring to ignoble and unsocial purposes of social outcasts.

down through the centuries for which history has been clearly written. To entertain that such conquest is futile is to indict the whole of mankind throughout the ages.

The greatest workers in physics have pointed out and in many cases actually carried through certain applications of science: witness the ophthalmoscope of Helmholtz, the miner's lamp of Davy, and many others. Kelvin said: ". . . in physical science many of the greatest advances that have been made from the beginning of the world to the present time have been in the earnest desire to turn the knowledge of the properties of matter to some purpose useful to mankind."

In considering the uses of sciences and the worthwhileness of science one is prone to recall the late wars and to ask semi-philosophic and semi-moral questions. Such uses do not concern us here and may be dismissed with a statement or two. The aims of science in peace time are to construct and to give the maximum of good to the world. The aims of science in wars are to construct as necessity demands only for the one party and to destroy most effectively the best of and to take the most from the other party. There is here not a question of science *versus* wars and destruction, but a peaceful *versus* a warlike state of mind. A state of rationality against a state of irrationality, more or less—a healthy mind against a pathological mind. These states of mind are entertained alike by all levels of society, as is amply recorded during the present and late wars, from those who apparently in peace time pursue scientific research with loftiest ideals, down to those who exist on the verge of mental anarchy. The group impulse overwhelms the individual. All social entities are builders in this world and rise to different scaffolding levels with the ages. As the workers on the ground have only mud and pickaxes with which to build, so they have also only these with which to menace. So, too, every age has its tools, whether for social good or for social menace.

Sometimes a differentiation is made on the grounds of being exact and applied. Such demarcation is more applicable to mathematics as such in contrast to all other sciences. Mathematics strives for the accuracy that only logic can attain. Nothing is too small or too large to be reckoned with. In fact, relative magnitude in general does not set relative importance of quantities, as it does in all other sciences. In physics, for instance, one strives to take account of as small quantities of things as it may be practical or possible in any given experiment to do so. Enormous efforts are made in the perfection of methods and of apparatus in order to take account of smaller and smaller relative amounts of a thing or of the effect. So, in any application of mathematics to physics, summations, for example, are carried out only to such extent as is consistent with the attainments of experiments. In applied science (in general, the engineering sciences) relative magnitudes become even more important. Small relative quantities of any thing or effect are ignored as soon as it is shown that they are of no practical importance; and enormously large quantities are avoided. Accuracy without limit is a characteristic of mathematical logic; accuracy as great as may be attained is the aim in physics; accuracy as good as need be is the practice in engineering.

One sees no practical and logical basis of differentiation between any two phases of science by motives alone, nor by the uses of the subject-matter. We must return, then, to the nature of the subject-matter itself and the manner of treating it, or its interrelations. As has already been hinted at, what is ordinarily clearly classed as applied science is in some way connected with some commodity of commerce. We find also that what is clearly pure science is far removed from any commodity, although sometimes it appears to be intimately associated with a commodity. However, this idea does present a basis for a logical differentiation between pure and applied science. For logic all sciences look to mathematics. Mathematics has also two viewpoints of the pure and the applied mathematics. We may expect, then, that mathematics may be clear on definitions of parts of itself, and perhaps may suggest a basis of definition that is useful in all cases. This is found to be the case.[3] We then may proceed to differentiate between pure and applied science on the basis of subject-matter chiefly and on the manner in which any particular portion of subject-matter is related to the general subject-matter. First, however, a few statements will be introduced to bring out what is meant by certain useful terms, proposition, propositional function, verifiers, falsifiers, that are not commonly found in the physical sciences.

All of the physical sciences have the objective viewpoint. That is, they deal with objects of the external world that exist independently of and outside of ourselves. These objects have various properties, some of which enable the object to stimulate sense organs in what is termed an adequate manner, so as to make us aware of its existence. In general, it is never an isolated body nor a single property of the object that is the stimulating factor. There is always a complex of stimuli to which our sense organs are exposed. Likewise, such complexes of stimuli give rise to complexes of sensations. We analyze the complexes of sensations when we learn about the ob-

[3] In this connection reference may be made to Keyser, "Mathematical Philosophy," Dutton and Co., 1922.

jects of the universe. Abstractions are formed into concepts of things and of relations between things. New things and new relations may be discovered. Many things are found to be related in many ways. These relations, more or less general, are usually referred to as laws. The primary aim of a great portion of science is to discover these laws. The properties of matter and of organisms are studied and compiled in order that new and more general relations may be discerned. Such general relations may be termed propositions, irrespective of whether they have been dignified as laws. Propositions are bound together with other propositions into more general relations and more far-reaching, which in turn may be called propositional functions. Now, pure science is in search of propositions and of propositional functions. Pure science is interested in the special properties of matter only in so far as they are "verifiers" or "falsifiers" of propositions and propositional functions. It must in most cases proceed from the facts of individual species of matter and move on inductively. However, having once established or arrived at a proposition or propositional function, it may proceed deductively. The singular fact is that a proposition or a propositional function may guide into paths not dreamed of during its formulation. So, in fact, we might cite as an illustration of a proposition, that when thinking is logical, the conclusions arrived at are very frequently found to fit experience in far-removed and new fields. Somehow, the guiding that makes us feel that a process of thinking is logical is also connected with the restraining or guiding in the processes of nature. Herein lies the power of mathematical logic when applied to physics or to any other branch of science. A very good illustration of a propositional function in physics is the theory of relativity, with its deduced proposition that electromagnetic wave radiation is subject to gravitation. A particular verifier is the influence of the sun upon a beam of light passing near it.

Pure science, then, deals with the propositions and propositional functions and with properties of materials in so far as they furnish verifiers or falsifiers of the propositions and propositional functions, or in so far as they may be made the basis for new propositions. Applied science, on the other hand, as has already been intimated, is associated with some commodity of commerce or with some substance or thing which is destined to become such. That is, it is concerned with particular verifiers and falsifiers that are directly associated with a commodity. It is interested in all properties which the commodity has and even in those of other commodities and materials that have a bearing upon the commodity in question. It is interested in materials entirely different from the commodity in so far as it may be possible and necessary to have substitutes, either for the purpose of bettering the commodity or the service it renders, or for the purpose of controlling the market more efficiently. Here is noted an element of restraint in applied science that apparently did not enter into pure science. This is not, however, a clear difference between the two. Much of applied science is as individualistic as most of pure is. But the products of applied science have a social judgment placed upon them much sooner in general than those of pure science. After such social judgment has been made and especially if favorable or encouraging, a portion of the science thereafter connected with the product always remains more social, for then it means that the product is destined to be a commodity or closely associated with a commodity in some more or less direct manner. This portion (*i.e.*, the more social) will be under restraint, for a commodity is essentially a social thing and modern industry requires the concentrated efforts of talent, capital and labor. These restraints are not inherent in the subject-matter in general of applied science, nor in the mind of the investigator, but lie in the organization or institution responsible for the commodity. Or, they may lie in the mutual agreement between two or more organizations or institutions, or in the ethical coercion that may have grown up in any realm of thought or activity. The individual who does the technical or research work is selected so that his activities resulting in important developments—from whatsoever motive so far as he himself is concerned—may fit into the restrained order of things. It is obvious that this is not a restraining that exists in or is peculiar to industrial laboratories only where most of the scientific work done is applied science; and that such restraints exist in other institutions as well. In scientific institutions that are endowed for a particular purpose the same restraining influences manifest, and in other educational institutions as well. Some kind of restraint is inevitable in any social undertaking.

There are various attributes that are frequently assigned to either pure or applied science which now are obviously only part descriptions in the light of these definitions. For instance, consider the matter of patentability. Letters patent, copyrights and franchises of any kind are essentially applicable to commodities or to processes related directly to commodities. Propositions and propositional functions are not subjects patentable. We might expect, then, that applied science and not pure science should concern itself about them. The attributes of timeliness and of being individualistic are possessed the more or less by applied science according as the commodity with which the applied science is associated possesses them. Again, because a portion of applied science requires greater social co-operation than most of pure

science generally does, the matter of proper units and standards wherewith to gauge the performance and composition of the commodity in a manner that will have unity of meaning and universal acceptance, is very early of serious concern to applied science.

If, then, we must use the terms pure and applied science, a differentiation based on the grounds of subject-matter and relationships found in the subject-matter is the more preferable. Applied science deals with the properties of commodities, or with properties of materials more or less directly connected with the production, distribution or utilization of commodities. It is interested in pure science in so far as the latter may give the general formulas by which particular behavior may be foretold, or the behavior of one kind of material may be compared with that of another kind which is involved in a given commodity or may become a substitute for the commodity. In addition, applied science is interested in pure science in so far as any particular verifiers or falsifiers may suggest new kinds of commodities, or new ways of effecting the production, distribution and utilization of commodities. Pure science is concerned with the propositions and propositional functions of science. It is interested in applied science in so far as the latter may furnish particular verifiers and falsifiers of propositions and of propositional functions. In addition, it is interested in applied science in so far as the data may suggest new avenues to new propositions.

ENOCH KARRER

NELA RESEARCH LABORATORIES,
CLEVELAND, OHIO

THE AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE
THE LOS ANGELES MEETING

THE preliminary announcement of the seventy-seventh meeting of the American Association for the Advancement of Science to be held with the seventh annual meeting of the Pacific Division and the fourth annual meeting of the Southwestern Division at Los Angeles, from September 17 to 30, will shortly be mailed to the members. It is an attractive folder reflecting credit upon the Los Angeles committee on arrangements which assumed the entire expense of printing this announcement as well as the final program which will be distributed at the meeting in September. The well-known enterprise and hospitality of the Los Angeles people, together with its unique advantages as a convention city, gives assurance that the sojourner will be well taken care of and every provision made for the success of the meeting.

The total eclipse of September 10, which centers in the vicinity of Los Angeles, will occasion the presence of many distinguished astronomers from all parts of the world. A diagram of the path of the eclipse is presented in the folder with a table showing the duration of totality for various places. Quoting from the announcement the eclipse "will be of especial interest to astronomers and other scientists because of the unusual opportunity it will afford for undertaking observations with exceptionally powerful and complete equipment. This is due to the accessibility of much of the area within which the eclipse is total. The path of totality passes close to Los Angeles and over San Diego and many other towns which have excellent transportation facilities. Furthermore, the eclipse occurs at a season of the year and at a time of day when the prospect of clear skies is very good, as is shown by records extending over many years."

Naturally, astronomy will be featured rather strongly at the Los Angeles meeting. Detailed reports of observations of the eclipse are of course not to be expected. The astronomers in attendance will however meet under the auspices of the association, holding joint sessions of Section D with the thirtieth meeting of the American Astronomical Society, and the summer meeting of the Astronomical Society of the Pacific. These sessions will be held at the University of Southern California, the Laboratory of the Mount Wilson Observatory and the California Institute of Technology.

A symposium on "Eclipses and Relativity," with Dr. W. W. Campbell, president of the University of California; Dr. Charles E. St. John, of Mount Wilson Observatory, and Dr. S. A. Mitchell, of the University of Virginia, as speakers, will be a feature of the general sessions at the University of Southern California.

A Research Conference will be held Monday at noon, September 17, during the luncheon period. The encouragement and coordination of research work on the Pacific Coast will be discussed and delegates will be heard from the various universities and research institutions in this field.

The Los Angeles meeting will be formally opened Monday evening, September 17, in the Bovard Auditorium, University of Southern California, with an address by President E. P. Lewis, of the Pacific Division of the American Association for the Advancement of Science, following which the usual public reception will be held.

On Monday afternoon, September 17, the symposium on "Eclipses and Relativity" will be held. It is represented that this discussion will be judiciously bereft of some of its inherent technicalities and suited to the comprehension of the average layman. It will prove a most attractive feature of the general sessions.

A banquet will be arranged for Tuesday evening, September 18, at 6:30 for all members of the asso-

ciation and affiliated societies. Following the dinner, adjournment will be taken to Bovard Auditorium, where at 8:00 P. M. an address will be given by Dr. John C. Merriam, president of the Carnegie Institution of Washington. Dr. Merriam has chosen for his subject the famous La Brea Deposits with the discovery and exploitation of which he has been closely connected. A wonderful display of fossils from Rancho La Brea is on exhibit at the Museum of History, Science and Art, a short distance from Bovard Auditorium.

On Wednesday evening, September 19, an address will be given by Dr. R. B. von Kleinsmid, president of the University of Southern California, "Science in its Relationship to Liberal Education."

MEETINGS OF SOCIETIES

Twenty-five affiliated societies announce meetings to be held under the general auspices of the association. Except in the case of the astronomical societies, some of whose meetings will be held in Pasadena, these meetings will all be accommodated in the George Finley Bovard Administration Building of the University of Southern California. The American Association of Petroleum Geologists will hold its regular meetings from September 20 to 22, immediately following the period announced for the other meetings.

The following societies are planning to hold meetings:

The American Association of Economic Entomologists
The American Association of Petroleum Geologists
The American Astronomical Society
Section D (Astronomy), The American Association for the Advancement of Science
The Astronomical Society of the Pacific
The American Chemical Society, California Section
The American Chemical Society, Southern California Section
The American Meteorological Society
The American Physical Society
The American Phytopathological Society, Pacific Division
The Cooper Ornithological Club, Northern Division
The Cooper Ornithological Club, Southern Division
The Cordilleran Section, The Geological Society of America
The Ecological Society of America
The Lorquin Natural History Club of the Southwest Museum
The Pacific Coast Branch Paleontological Society
The Pacific Coast Entomological Society
The Pacific Division of the Plant Physiological Section of the Botanical Society of America
The Pacific Fisheries Society
The San Francisco Section, The American Mathematical Society
The San Francisco Society, The Archeological Institute of America
The Seismological Society of America
The Southern California Section, The American Society of Mammalogists
The Western Psychological Association
The Western Society of Naturalists

W. W. SARGEANT,
Secretary, Pacific Division

THE NEW MARINE BIOLOGICAL RESEARCH STATION OF THE BERGEN MUSEUM, NORWAY

THE first marine biological station in Norway was built in 1891. It was situated in the city of Bergen and was connected with the museum there, where investigations of the particularly rich marine fauna of the west coast of Norway have formed the chief part of the zoological work for almost one hundred years.

For thirty years this first biological station was of great importance to Norwegian and foreign scientists; but it then became necessary to discontinue it, owing to the increasing pollution of the available sea-water, caused by the growth of the city.

Thanks to the generosity of private individuals it has been possible for the Bergen Museum to build a new and larger biological station, now finished and open for workers.

The station is situated on the island of Herdla in the archipelago, about 17 miles from Bergen. This locality has been chosen so as to assure a perfect supply of sea-water, and so that the laboratories are situated as close to the working field as possible. From this place one is able to reach any of the biological localities typical of the west coast of Norway in the course of two hours' sailing at most. Furthermore, the short distances to be covered are important because the greatest difficulties attend the transport of the more frail marine organisms from the place of capture to the aquaria in the laboratories, and the animals are often dying or dead when they reach there. It has thus been possible to keep for eight months in the aquaria crustaceans caught at a depth of 300 metres.

The west coast of Norway offers a very rich field for marine biological work, and owing to the great variety of bottom and depth, the fauna is correspondingly varied. The archipelago, consisting of many smaller and larger islands, also makes the sea-surface calm enough for this kind of investigation, in spite of the proximity of the open Norwegian Sea. Finally, this locality has the great advantage that the sea never freezes over, and it is thus possible to collect material throughout the winter, while at places even further south ice conditions prevent this.

The station building contains five laboratories and a larger room for instruction purposes. During the summer ten scientists can be accommodated, and dur-

ing the winter five, besides the staff. On the second floor are the library and private rooms for the visiting scientists, who also get their board at the station, at reasonable cost.

Besides smaller boats the station owns a special vessel, the "Herman Friele," of 23 tons, constructed for all kinds of marine investigations.

The opportunities for working at this station are open to scientists of all countries. There are no fees for this, because it is considered to be the main objective of the station to promote marine investigations as fully as possible. For the present no regular investigations are planned by the station, as it is the purpose to supply the scientists working there with as much material as possible for their investigations. As conditions improve, it is proposed that the station take up again the international courses of instruction in marine investigations carried on until 1914 at the Bergen Museum, and which met with so great a response from the different countries of Europe. Scientific workers who are interested in securing opportunities for a stay at this station are requested to communicate with the writer.

AUG. BRINKMANN, *Director*

BERGEN MUSEUM,
BERGEN, NORWAY

SCIENTIFIC EVENTS

MEMORIAL PORTRAIT OF ALFRED RUSSEL WALLACE

A MEMORIAL portrait of Dr. Alfred Russel Wallace, joint author, with Darwin, of the theory of natural selection, was unveiled on June 23 at the Natural History Museum, South Kensington, by Sir Charles S. Sherrington, President of the Royal Society. The present year is the centenary of Dr. Wallace's birth.

Sir James Marchant offered the portrait to the trustees on behalf of the memorial committee, and after unveiling it, according to the report in the London *Times,* Sir Charles Sherrington said:

The portrait that has a fitting place within the walls of this building in memory of Alfred Russel Wallace will be cherished for many reasons here. To those great collections for which this building is the house and the shrine he contributed generously and largely. Much of the fruit that he gathered in his expeditions in the Malay Archipelago enriches the galleries here. But he did even more for this collection and for all collections of natural history throughout the world by contributing a renowned and fertile idea which has lent and lends them a further significance and a new meaning. He contributed an interpretation which forms a guiding thread to a great deal of the study which such collections as this render possible. He and his great compeer (Darwin), by whose statue we stand now, gave a further setting to the whole of the arrangements of such a museum as we are now in, and much of their interpretation, much of their study, bears, further, the great interest that it has applications even to human society itself. To Wallace, ardent, relatively young, intensely curious into the economy of nature, and faced with the prodigality, the almost wasteful luxuriance of nature in the tropics, there arose the idea to which has been given a term that has passed into common parlance—the "struggle of existence" in animate nature in relation to and in its bearing upon the origin of all that astounding, varied manifoldness of feature that the world exhibits—the origin of species. And that idea, taking its growth from him and from his great, his illustrious friend and colleague, has since that time, since he formulated it even briefly, been, I suppose, and stands still, the dominant underlying motive that guides the study and arrangement of these collections. I suppose that that happy circumstance of the juxtaposition of the portrait that we see there and of the statue by which we are standing represents in collocation the commemoration of two men of whom it may be said, perhaps, that never a day passes but their two names rise to the memories of the director and the distinguished staff who are with him to study and to help others to study these collections. Circumstances arranged that the discoveries of these two men came, as it were, at the same moment and on the very same theme side by side before the scientific world. Such an attendant circumstance might, in some cases, have proved an embarrassment to one or other of them, but, as we all know, instead of being an embarrassment it formed a bond of generous association between them, each one of them striving to exalt the merits of the other. That part of the history of science will ever remain as a noble and inspiring feature connected with the work of these two men. Therefore the picture that we have there is not only a memorial of one whose memory is part of the historic treasure of science, but it will also be an abiding source of inspiration for the future, inasmuch as it represents a noble trait of character as well as genius, which went together in the personality of Alfred Russel Wallace.

Professor E. B. Poulton, F.R.S., spoke on Wallace's life and work, and also bore testimony to his generous character and to the enthusiasm with which he entered into and promoted the scientific work of others; and the Archbishop of Canterbury expressed the ready welcome which the trustees gave to that striking portrait of a remarkable man.

THE ZOOLOGICAL RECORD

DR. WITMER STONE, executive curator of the Academy of Natural Sciences, Philadelphia, and chairman of the library committee, has addressed the following letter to zoological and other societies in America:

In SCIENCE for May 18, 1923, page 577, is published a letter from Mr. P. Chalmers Mitchell, of The Zoological Society of London, on the financial status of *The Zoological Record.* It states that the annual loss to the society on the issues of the *Record* is over £1,100 and is likely to increase; that a statement issued by the Council of

the Zoological Society in the Spring of 1922, addressed to zoologists and zoological institutions throughout the world, asking for support, has produced an unsatisfactory response; that, unless substantial help is forthcoming, the *Record* will be discontinued; but that the Zoological Society is "ready to continue the *Record*, and to regard a loss of £500 a year as part of our contribution to the common good of zoological science, if other institutions guarantee us against further loss."

The Library Committee of the Academy of Natural Sciences of Philadelphia has been authorized by the Council of the Academy to offer to the Zoological Society of London a guarantee of One Hundred Dollars toward any deficit that may arise during the year ending July 1, 1924, resulting from the publication of the volume of the *Record* issued during that year, and to communicate its action to other zoological institutions, inviting them to take similar action.

We believe that the discontinuance of *The Zoological Record* would be unquestionably a great calamity to zoologists everywhere. We would therefore urge you to consider, as soon as possible, the question of offering a sum to the Zoological Society of London as a contribution to the guarantee fund asked for in Mr. Mitchell's letter and to communicate any affirmative action to the undersigned and to send any contribution direct to the Zoological Society at Regent's Park, London, N. W. 8.

THE REMOVAL OF THE DIRECTOR OF THE RECLAMATION SERVICE

Engineers are protesting against the removal of Arthur P. Davis as director of the U. S. Reclamation Service. Secretary Work's action is characterized as prejudicial to the public interest and the secretary is described as pursuing a dangerous course. The Federated American Engineering Societies have raised formal and vigorous objection to the displacement of Director Davis. The position of the federation is explained in a statement by Executive Secretary L. W. Wallace, in which he says:

Because of the far-reaching results that might ensue and because of the seriousness of the situation, the organized engineers and technical men of the United States are preparing to make a thorough search into the considerations that led to the action taken in regard to the Reclamation Service. The American Society of Civil Engineers has appointed a special committee to investigate the matter. The public affairs committee of the Federated American Engineering Societies, of which J. Parke Channing of New York is chairman, has already addressed a letter of inquiry to the secretary of the interior concerning the action.

This is being done not from the standpoint of questioning the right of a Government official to discharge any one that he may elect, but from the point of view of the wisdom of the announced policy that a technical bureau can be more effectively directed by a man not technically trained and fitted in comparison with one so technically trained and fitted.

The work of the Reclamation Service is essentially engineering and technical. There are business aspects, to be true, but so far as is known there has been no criticism of the business direction of the Service, other than perhaps by certain interests in the West who have endeavored to secure a reduction in or have endeavored to repudiate payments for reclaimed lands purchased.

Should this demand prevail, the fundamental principle of the enabling act will be displaced and the revolving fund for the continuation of the work will be dissipated, so that other needed projects can not be carried out unless there be additional drains upon the Treasury of the United States. Furthermore, should such an eventuality ensue public confidence in the integrity of the direction of such work would be so shaken as to make it difficult to secure appropriations from Congress to extend the work of reclaiming the arid lands of the west.

In the main, the support for such has come from the West, but should there be a question as to the wisdom with which the projects are selected and executed, then it is entirely probable that the West would not receive support from other sections of the country. Therefore, not only is the morale of the technical service at issue but also the larger thing, perhaps reclamation itself.

INTERNATIONAL CONGRESSES OF PHYSIOLOGY AND PSYCHOLOGY

The eleventh International Physiological Congress, which will be held at Edinburgh on July 23–27, under the presidency of Sir Edward Sharpey Schafer, is apparently the first scientific meeting of its kind in Scotland, and promises to be very successful. Already more than 250 physiologists from various parts of the world have signified their intention of attending the meeting, and a large number of countries will be represented. The largest contingent from abroad is coming from the United States and Canada, and will number about forty. A second notice has just been circulated, from which we see that, on presentation of an official voucher, return tickets to Edinburgh will be issued at a single fare and a third by any railway booking office in Britain. The provisional program of the congress includes a reception by the Lord Provost of Edinburgh and an address by Professor J. J. R. Macleod, of Toronto, on insulin. Those who intend to take part in the congress should, unless they have already done so, communicate with one of the secretaries, Professor G. Barger or Professor J. C. Meakins, University of Edinburgh.

The seventh International Congress of Psychology will be held at Oxford on July 26–August 2, and will differ from preceding congresses in that it will be restricted to 200 members, membership being confined to trained psychologists, and a few others approved by the committee. It is hoped to provide international symposia on subjects of present interest, the contributions being circulated in advance, and each

day will be devoted to a different aspect of psychology (general, educational, industrial, medical, social, etc.). The mornings will be occupied in the discussion of more general problems (such as the perception of time, the perception of form, the nature of general ability, the concepts of mental and nervous energy, the principles of vocational testing, the psychological value of certain psychoanalytic views), and the afternoons in the presentation of a limited number of papers offered by individual members. Exhibits of apparatus and less technical lectures will be also arranged. The recognized languages of the congress will be English, French, German and Italian.—*From Nature.*

THE LIVERPOOL MEETING OF THE BRITISH ASSOCIATION

THE "Preliminary Program and Invitation Circular" for the approaching Liverpool meeting of the British Association for the Advancement of Science has recently been received. The meeting will occur from Wednesday, September 12, to Wednesday, September 19. Members of the American Association have been cordially invited to attend the meeting and those planning to be present may secure copies of the Preliminary Program, etc., by applying to the Secretary of the British Association, Burlington House, London, W. 1. They are requested also to inform the Washington office of the American Association. It is desirable that our own records show approximately the number of our members who attend the British Association meeting. The Local Secretaries' office for the meeting will be in the Manesty Building, College Lane, Liverpool, till September 10. The Reception Room for the meeting will be at St. George's Hall.

The Liverpool meeting will be under the presidency of the noted physicist, Professor Sir Ernest Rutherford, and it will be the ninety-first annual meeting of the British Association. The inaugural general meeting will occur at 8:30 P. M., on Wednesday, September 12. At this meeting Sir Ernest Rutherford will deliver the presidential address, on "The electrical structure of matter." On the following days will occur the addresses of the sectional presidents, which are announced as follows:

Section A (Mathematics and Physics). Professor J. C. McLennan, on *The Origin of Spectra.*

Section B (Chemistry). Professor F. G. Donnan, on *The Physical Chemistry of Interfaces.*

Section C (Geology). Doctor Gertrude Elles, on *Some Aspects of Evolutional Paleontology.*

Section D (Zoology). Professor J. H. Ashworth, on *Modern Zoology: its Boundaries and some of its Bearings on Human Welfare.*

Section E (Geography). Doctor Vaughan Cornish, on *The Position and Opportunity of the British Empire.*

Section F (Economic Science and Statistics). Sir W. H. Beveridge, on *Unemployment and Population.*

Section G (Engineering). Sir H. Fowler, on *Transport and its Indebtedness to Science.*

Section H (Anthropology). Professor P. E. Newberry, on *Egypt as a field for Anthropological Research.*

Section I (Physiology). Professor G. H. F. Nuttall, on *Symbiosis in Animals and Plants.*

Section J (Psychology). Mr. C. Burt, on *The Mental Differences between Individuals.*

Section K (Botany). Mr. A. G. Tansley, on *The Present Position of Botany.*

Section L (Educational Sciences). Professor T. P. Nunn, on *The Education of Demos.*

Section M (Agriculture). Doctor C. Crowther, on *Science and the Agricultural Crisis.*

Numerous discussions are announced, some of the topics being: *Cohesion and Molecular Forces, Vocational Tests for Engineering Trades, The Physical Chemistry of Membranes in relation to Physiological Science, The Delinquent Child* and *Virus Diseases of Plants.*

Saturday, September 15, is to be devoted to excursions. An exhibition of scientific apparatus is being organized and a meteorological demonstration is being arranged.

The annual meeting for 1924 will be held in Toronto, Canada.

BURTON E. LIVINGSTON,
Permanent Secretary, A. A. A. S.

THE AMERICAN ASSOCIATION OF PETROLEUM GEOLOGISTS

THE American Association of Petroleum Geologists will hold a mid-year meeting in Los Angeles on September 20, 21 and 22. The program will be devoted to (a) papers on geologic theory with special reference to the origin and occurrence of oil and gas, (b) papers on the geology and development of California oil fields, and (c) papers on geologic problems in the major oil regions, domestic and foreign. The sessions promise to be specially interesting and unusually rich in contributions to geologic theory.

The meeting follows immediately the Special Summer Meeting of the American Association for the Advancement of Science, and at the same place, making attendance at both meetings particularly convenient. The American Association of Petroleum Geologists hopes that many, perhaps all, of those attending the earlier meeting may remain over for the latter. Every member of the American Association for the Advancement of Science, whether geologist or not, will find this meeting interesting and profitable, and every member is warmly invited to attend and to take part in the discussions.

MAX W. BALL,
President

SCIENTIFIC NOTES AND NEWS

At the congregation of the University of Cambridge, England, held on June 12, the honorary degree of doctor of science was conferred upon Dr. William Henry Welch, director of the School of Hygiene and Public Health of the Johns Hopkins University.

At the commencement exercises of Oberlin College on June 20, the honorary degree of doctor of science was awarded to Professor Charles J. Chamberlain and Professor Henry C. Cowles, both of whom are members of the staff of the department of botany of the University of Chicago. Professor Chamberlain was a member of the Oberlin class of 1888, and Professor Cowles of the Oberlin class of 1893.

Drury College, on the occasion of its fiftieth anniversary, May 30, conferred upon Benjamin F. Finkel, Ph.D., of the chair of mathematics, and on Edward M. Shepard, Sc.D., retired professor of geology, the honorary degree of LL.D.

Gerald Swope, president of the General Electric Company, Schenectady, N. Y., received the honorary degree of doctor of science from Rutgers College and the State University of New Jersey, at the commencement exercises on June 12.

Clarence L. Law has been elected president of the Illuminating Engineering Society for the coming year.

Dr. Frederick B. Power, in charge of the phytochemical laboratory of the Bureau of Chemistry, Washington, D. C., was recently elected to honorary membership in the New York State Pharmaceutical Association.

Professor Nils Bohr was made an honorary member of the Cambridge Philosophical Society and received the honorary degree of doctor of science from the University of Cambridge on June 12.

The Albert Medal of the Royal Society of Arts has been awarded this year in duplicate to Sir David Bruce and Sir Ronald Ross, in recognition of the eminent services they have rendered to the economic development of the world by their achievements in biological research and the study of tropical diseases.

Dr. Matthias Nicoll, Jr., has been appointed to succeed the late Dr. Hermann M. Biggs as New York State Commissioner of Health.

The Ohio Agricultural Experiment Station announces that the position of nutrition chemist in the department of animal industry has been filled through the appointment of Roland M. Bethke, Ph.D., Wisconsin, '23.

Dr. John Palibin, director of the Botanical Garden at Batoum, has accepted the post of assistant to the museum director in the botanical garden of Petrograd.

At the annual meeting of the New York State Association of Consulting Psychologists the following officers were elected: *President*, Dr. David Mitchell; *Vice-President*, Dr. Mark A. May; *Secretary-Treasurer*, Miss Elizabeth A. Walsh; *Member of the Executive Committee*, Dr. Dean R. Brimhall, to fill out the unexpired term of Dr. Ruth Swan Clark, who has resigned.

Nature announces the resignation of Sir George Beilby after nearly seven years' voluntary service as director of fuel research and chairman of the Fuel Research Board under the Department of Scientific and Industrial Research, which was established in 1917 to investigate the nature, preparation and utilization of fuel of all kinds. Dr. C. H. Lauder has been appointed director of fuel research and Sir Richard Threlfall, a present member of the board, chairman. Sir Charles Parsons will continue as a member of the board for a further period. Sir George Beilby retains his membership of the advisory council of the department and has consented to act as honorary adviser to the board. The following have been appointed additional members: Mr. R. A. Burrows, Sir John Cadman, Dr. Charles Carpenter, Mr. Samuel Tagg, Sir James Walker and Professor R. V. Wheeler.

The following named fellows of the American Association for the Advancement of Science have been appointed as official representatives of the Association at the approaching meeting of the British Association for the Advancement of Science, which will occur from September 12 to 19 at Liverpool: S. C. Brooks, biologist, Hygienic Laboratory, U. S. Public Health Service, Washington, D. C.; Frederic S. Lee, professor of physiology, College of Physicians and Surgeons, Columbia University; G. N. Lewis, professor of chemistry and dean of the College of Chemistry of the University of California; A. P. Mathews, head of the department of physiological chemistry of the University of Cincinnati; A. R. Moore, professor of physiology at Rutgers College; William A. Noyes, professor of chemistry and director of the chemical laboratory of the University of Illinois.

Mr. Elmer D. Merrill, director of the Bureau of Science, Manila, will represent the Bureau of Science at the second Pan-Pacific Science Congress to be held in Sydney and Melbourne in August.

Dr. S. C. Brooks and Dr. M. M. Brooks, biologist and assistant biologist, respectively, of the Hygienic Laboratory, Washington, D. C., will spend the sum-

mer abroad visiting various scientific laboratories and attending the Eleventh International Physiological Conference at Edinburgh.

A. A. JOHNSON, formerly director of the Institute of Applied Agriculture at Farmingdale, L. I., has just returned from a three months' trip to Russia where he had gone to represent American machinery interests and to make arrangements for American participation at the Industrial Exhibition at Moscow in August. Mr. Johnson, in 1921, was appointed chairman of the Russian Relief Commission to investigate famine conditions and to make recommendations.

DR. WILLIAM WALTER CORT, associate professor of helminthology in the School of Hygiene and Public Health of the Johns Hopkins University, has sailed from San Francisco for Peking, where he will serve as exchange professor in parasitology in the Peking Union Medical College during the next academic year. Dr. N. R. Stoll, graduate student in the School of Hygiene and a research fellow under appointment by the Rockefeller Foundation, accompanied Dr. Cort.

HARLAN I. SMITH, of the National Museum of Canada, is continuing his researches in the Bellacoola area of British Columbia. He is also arranging for Mackenzie Park, a proposed out-of-door museum, forest reserve and animal sanctuary, as a monument to Sir Alexander Mackenzie, the first white man to cross Canada.

DR. LAFAYETTE B. MENDEL, professor of physiological chemistry in Yale University, who has been giving a course of lectures at the University of California, recently addressed a symposium of physicians in Los Angeles, the Santa Barbara County Medical Association, the California Academy of Medicine, the San Francisco Dental Society, the students of Mills College, Oakland, and other groups along the Pacific Coast upon topics pertaining to nutrition.

DR. HENRY B. WARD, national president of Sigma Xi, addressed the Sigma Xi Club of Southern California on the evening of June 16 at the Maryland Hotel, Pasadena, on "The Future of Sigma Xi." Professor Ephraim Miller, formerly of the University of Kansas, who has passed his ninetieth birthday, was present and spoke briefly.

DR. EDWARD V. B. HARLEY, professor of pathological chemistry in University College, London, died suddenly on May 21, aged fifty-nine years.

FORMAL dedication of the Irving Porter Church telescope recently installed in Fuertes Observatory, Cornell University, was held at Rockefeller Hall during commencement week. The main address was made by Dr. H. D. Curtis, director of the Allegheny Observatory, who traced the influence of astronomy on modern thought.

ONE of the new buildings of the University of Alabama School of Medicine, Tuscaloosa, will be named after Josiah Clark Nott, the founder of the Medical College of Alabama, Mobile, 1859. The college was removed to Tuscaloosa in 1920.

LIEUTENANT-COLONEL JAMES CURRIE ROBERTSON, formerly sanitary commissioner with the government of India, died on May 14.

THE death is announced from Brazil of M. Chrostowski, the Polish ornithologist. M. Chrostowski was well known through his investigations into the tropical fauna of South America in the little known districts of Iguaca and Rio Negro. He was the author of numerous books published in Polish, English and French. According to a Reuter despatch, in company with another Polish ornithologist, he embarked on an expedition to Brazil in 1921 at his own expense, and was preparing to return to Poland when he succumbed to marsh fever.

WE learn from the *Journal* of the American Medical Association that Count Matsuda, ambassador from Japan, accompanied by the high officials of the Japanese embassy, recently deposited two beautiful vases, representing Japanese art, in the crypt of the tomb of Pasteur, at the Institut de la rue Dutot. The ambassador has also turned over to Dr. Roux, director of the Pasteur Institute, the sum of 108,000 francs, collected by the scholars and scientists of Japan. In a short presentation address, Count Matsuda gave expression to the admiration and gratitude felt by his compatriots for the work of Pasteur. Dr. Roux, in turn, expressed his thanks in the name of his colleagues and emphasized the fact that Japan was one of the nations which had understood how best to apply the discoveries of Pasteur, not only for the protection of public health but also for the progress of their industries, especially the raising of silkworms. He also referred to the valuable contributions to science made by Japanese scientists, several of whom had worked in the laboratories of the Pasteur Institute at Paris.

ARTHUR WILLIAM BACOT, entomologist to the Lister Institute of Preventive Medicine, lost his life a little more than a year ago in the course of an experimental inquiry into the rôle of the louse in the transmisison of typhus. We learn from *Nature* that several of Mr. Bacot's friends and colleagues have thought that some memorial of him ought to be established in the village where he resided and, before his appointment to the staff of the Lister Institute, carried out important medico-entomological researches. Bacot entered the ranks of specialist investigators from those of ama-

teur naturalists and nature students, and always attached the greatest importance to the teaching of nature study in the elementary schools. His colleagues and friends believe that the form of recognition which would have been most congenial to his feelings would be the provision of assistance to the authorities of the council schools in his home (Loughton) in furthering the study of natural history. With that object, a fund has been opened—the Bacot Memorial fund.

An international memorial apicultural library dedicated to the memory of Dr. Charles C. Miller, a famous American beekeeper, of Marengo, Illinois, has been established at the University of Wisconsin. A sum of $1,500 to $2,000 has been donated by beekeepers from all parts of the world, and the interest from this sum will be used in making additions to the library. Many hundreds of volumes of journals and books have been donated by beekeepers and scientists, and it is the plan of the committee in charge to make this one of the best apicultural libraries in the world. The library is to be dedicated at a conference of beekeepers to be held at Madison, Wisconsin, during the week of August 13 to 18. Many prominent authorities on the subject of apiculture will attend the meeting and give addresses on some phase of this subject. On Saturday of that week, a pilgrimage by automobile will be made from Madison to Marengo, Illinois, where the dedication ceremony will be conducted and a memorial tablet placed in the church.

Burt P. Garnett, who has been technical manager of the A. C. S. News Service and managing editor of the News Edition of the *Journal of Industrial and Engineering Chemistry*, has launched a news syndicate under his own name in Washington. This work will consist of the preparation of articles for the newspapers and magazines on technical and scientific subjects. Hereafter the publicity work of the Society will be in charge of James T. Grady, director of the department of public information, Columbia University. The managing editorship of the News Edition has been entrusted to Dr. Robert P. Fischelis, dean and professor of pharmaceutical chemistry at the New Jersey College of Pharmacy, Newark, N. J. Dr. Fischelis has been a member of the staff of *Industrial and Engineering Chemistry* for several years.

Owing to the death of Dr. Harold C. Ernst, Boston, editor of the *Journal of Medical Research* since 1896, that journal has become the property of the American Association of Pathologists and Bacteriologists and will be published in the future by a board of editors appointed by the council of the association. It will be devoted to the prompt publication of original observations and investigations in the field of pathology. Communications should be addressed to the editor-in-chief, Dr. F. B. Mallory, Boston City Hospital, Boston.

The National Academy of Sciences will hold its autumn meeting at Cornell University in November.

UNIVERSITY AND EDUCATIONAL NOTES

The University of Denver has received the largest single gift in its history in the form of real estate property valued at $1,500,000 from James H. Causey, Denver business man and former partner of Governor Sweet, of Colorado. Mr. Causey has placed no restrictions on the use to which the gift shall be put, although in a letter to the board of trustees he stated that he would like to see the income used for "the creating of international, social and industrial good will."

Tufts College dedicated on June 16 the new chemical laboratory built at a cost of $300,000, which will be ready for use in the fall. Addresses were made by Professor Arthur B. Lamb, of Harvard University, and by Professor Charles A. Kraus, of Clark University. Dr. Arthur Michael, formerly professor of chemistry at Tufts, was the guest of honor. In addition to this new equipment, the college has just completed its campaign for a $1,000,000 endowment fund.

Dr. W. A. Hamilton, professor of mathematics at Beloit College, and Dr. E. S. Haynes, professor of astronomy, have resigned their positions in protest at the action of the board of trustees, who forced the resignation of Professor C. L. Clarke, dean of men at Beloit, in order to make way for the appointment of another member of the faculty to the deanship. Both Dr. Hamilton and Dr. Haynes were members of an administrative committee which has been in charge of the college since the resignation of President M. A. Brannon last winter.

Dr. Henry D. Jump, Philadelphia, has accepted the chair of applied therapeutics in the Woman's Medical College. This fills one of the vacancies caused by faculty resignations when the Board of Corporators refused to reappoint Dr. Alice Weld Tallant to the chair of obstetrics at the college.

Herbert S. Hadley, formerly governor of Missouri, has been elected chancellor of Washington University (not of the University of Missouri as was incorrectly stated in last week's issue of Science). Dr. Hadley has been professor of law in the University of Colorado since 1917. He succeeds Dr. Frederic A. Hall, formerly professor of Greek, who became acting chancellor when Chancellor David F. Houston became secretary of agriculture, and was elected chancellor in 1917.

AT the University of Minnesota, Associate Professors Richard M. Elliott, William S. Foster and Donald G. Paterson, of the department of psychology, have been promoted to the rank of professor. Dr. Charles Bird has been promoted to be assistant professor of psychology.

DR. ISRAEL MAIZLISH has been appointed instructor in physics at Lehigh University.

DR. H. S. RAPER, of the University of Leeds, has been appointed professor of physiology at the University of Manchester.

DR. R. J. S. MCDOWALL, lecturer in experimental physiology and experimental pharmacology at Leeds, has been appointed professor of physiology at King's College, London.

DISCUSSION AND CORRESPONDENCE

MARINE WILCOX IN MEXICO

RECENTLY, the East Coast Oil Company, S. A., under my direction, drilled a deep test on Idol Island, which is in the Tamiahua lagoon about sixty miles south of Tampico. The location was made on what we hoped was the extension of one of the producing anticlines to the south. When oil in commercial quantity was not found at expected depth, the well was continued for exploratory purposes. The samples were carefully taken and the results from their study are of great interest and we hope to publish them shortly. In this notice it is only intended to discuss a single horizon found there. The method used in examination of samples was that first developed in our laboratory at Houston and described in a paper read before the Paleontological Society at Boston in 1921. This method has now come into general use in the Gulf Coast region and is giving excellent results. It is based, primarily, on occurrence of foraminifers either as individuals or in faunules, and we find it about as reliable in use as is the case with many molluscan faunas.

In the Idol Island well the samples from 1268 to 1800 feet showed the same assemblage of forms found in surface material taken near the top of the Alazan (Jackson) beds, while those from 1800 to 2500 correspond with the forms found in the Tantoyuca or lower Alazan. At 2500 feet there was a break evidenced by both lithologic and faunal changes. Between 2500 and 4200 feet the foraminiferal fauna is entirely new so far as we are aware. Apparently, this formation in its marine foraminiferal phase does not outcrop at the surface in Mexico. At about 4200 feet there was another change of material as the drill entered the Papagallos, and this carried the very characteristic fauna which we have been able to recognize in every sample of surface outcrop of this formation which we have had opportunity to study.

We had, therefore, in this well about 1700 feet of Eocene material between the known Jackson and known Cretaceous, the exact correlation of which we were unable to make other than that it was probably the coastal representative of some part of the Chicontopec of the interior region.

Within the last few days a series of samples has been received from a well in southern Angelina County, about one hundred miles north of Houston. The section as shown by these samples is almost entirely marine and generally highly fossiliferous.

The samples began at 930 feet. From that depth to 1127 the fauna is typically Jackson. There was then a break in samples to 2631 feet, below which the fauna was Claiborne in age. At 2800 feet the Queen City beds were found as non-fossiliferous sand 200 feet in thickness. The sample from 3003 feet was a core, highly fossiliferous. The foram fauna, which is abundant, contains only a single species found in the Claiborne, the remaining forms being absolutely different from those of that stage and from the Midway fauna, of which we have at least 100 collections. It is undoubtedly Wilcox in age. While the surface exposures of Wilcox are often fossiliferous, we know of none in which forams have heretofore been found. It is certainly the first discovery of such beds in Texas, and is of especial interest to us also in the fact that this fauna is practically identical with the one in the Idol Island well between 2500 and 4200 feet and especially with the forms below 3500 feet. The Texas fauna is more varied in genera and species, doubtless because it is a near-shore phase, while that of Mexico was laid down in deeper water. However, the dominant forms are the same in both and are not known in other formations in this region so far as we are aware.

A report on the geology of the Idol Island well is in preparation, which will give the details of which this is a brief summary.

E. T. DUMBLE

HOUSTON, TEXAS

BEHAVIOR OF THE THRESHER SHARK

NONE of the literature within my reach gives definite information as to the use of the extremely long, slender tail of the thresher shark (*Alopias vulpes*), although several writers refer to the general notion that it is used to frighten schools of fish in order to make them huddle close together. For that reason it seems to me that many non-specialists among readers of SCIENCE may be as much interested as specialists in a record of a recent observation near the end of

the pier belonging to the Scripps Institution at La Jolla. This point is about 1,000 feet from shore and the water is near thirty feet deep.

While taking my plankton collection at about 7:25 a. m., April 14, 1923, I heard a splash near by. Turning, I saw about one hundred feet distant a swirl in the water like that made by a California sea lion. A moment later a long, slender, compressed tail (about three feet long) flashed above the surface and lashed about like a coach whip. It evidently belonged to some shark-like creature with which I was not acquainted. This exhibit was quickly repeated once. The body was not visible at all.

At about 7:45, while draining some water through my filtration net I saw about fifty feet from the pier what appeared *at first* to be a "soup fin shark" (*Galeus zyopterus*). It was coming diagonally toward the surface and swimming rapidly. Almost immediately I noticed a small fish (possibly California smelt, *Atherinopsis californicus,* about ten inches long) frantically swimming just in front. A moment later the pursuer, a six-foot thresher shark, passed partly ahead of the victim (probably half its own length) when it turned quickly and gave the coach-whip lash with the tail which I had seen before. The victim was much confused, if not actually injured by the whiplike movement, which seemed to be very accurately aimed. The whip stroke was instantly repeated with very confusing speed, and it then became evident that the victim was seriously injured. It was, however, almost under the drip from my net, at which the shark was apparently frightened. The shark darted away and was not seen again. The victim sank, swimming feebly, then came to the surface and lay on its side awhile. Then it struggled feebly with head at surface, gasping. Finally it sank again until out of sight and was not seen again.

I was much impressed with the speed and skill with which the shark worked and with the accuracy shown in its strokes at a single flying target.

W. E. ALLEN

LA JOLLA, CALIFORNIA

ASYMMETRICAL ORATORY

IN the work of supervising class-room teachers during many years and in visiting class rooms in different parts of the country, I have frequently noted phenomena analogous to those described by Dr. W. Gilman Thompson (SCIENCE, March 16, 1923) as "right- and left-handedness in speakers."

Many teachers, especially when the class is large, focus their service upon a limited portion of the room to the almost complete neglect of the pupils in the marginal fringe. Whenever I brought this fact to the attention of teachers, I found that they were themselves unaware of it. On the other hand, I have met teachers who were aware of this tendency in themselves, and who attempted to counteract it by means of some mechanical device, such as seating plan or roll book, etc., to insure an equitable distribution of attention to all individuals.

The use of the right or left hand and arm to release the emotional strain for which the voice alone is not an adequate outlet may account for the asymmetrical presentation in the case of public speakers and orators. From my observation in schools I am inclined to attribute the limitation to some irregularity of vision. In many cases it is possible to detect deficient vision on the part of pupils by their posture and address.

This matter deserves more intensive and systematic study, both for the improvement of school-room technique and for the art of public speaking.

BENJ. C. GRUENBERG

NEW YORK

QUOTATIONS

MEDICAL PROGRESS

"EMOTIONAL tension," Sir Almroth Wright declared in a recent lecture on vaccination, "is intolerant of any intellectual *impasse.*" He was describing in outline the steps by which modern medicine has progressed towards a clearer knowledge of disease and of the mechanism of the body's protection against disease. Hypotheses are always tentative; of the best of them it may be said that, in a sense, they are made to be broken. Thus it was " 'the pain in the mind,' which is felt when one is appealed to and is powerless," to quote Sir Almroth again, which led Pasteur to revise his first theory of vaccination and so to achieve his great triumph over hydrophobia. Last week, at St. Mary's Hospital, Professor Dreyer, of Oxford, offered yet another extension of knowledge which is the outcome of revised opinions and changed ideas. His new treatment of tuberculosis, whether ultimately it stands or falls, is the last link in a chain extending back to Jenner. The chain is continuous, but its links are not, if the metaphor may be extended, of the same shape nor even of the same metal. In a series of monographs, of which we present some account to-day, Sir Almroth Wright has recently outlined his own revised opinions on the subject of vaccination against disease. These differ in many important respects from the views this pioneer held when he set himself to perfect the method of preventive inoculation against typhoid fever, which stood the world in so great stead during the years of the war. Sir Almroth no longer believes that our bodies elaborate a special and specific antidote against each germ which attacks them. Rather he takes the view that there is stored up in the white cells of the blood

a common stock of antidote which can be released very swiftly and which is capable of inflicting death on most of our microbic foes.

These are revolutionary opinions and it would be idle to pretend that, at present, they meet with general acceptance. Their importance, however, can not be disputed. Nor is it likely that the "pain in the mind" which gave them birth will suffer them to remain without the sustenance of continuous experimental proof. Vaccination is now fighting for first place among the weapons of cure. Thanks to Sir Almroth Wright, Professor Dreyer and others possessed of the same temper of mind, it has literally forced itself on the world. Failure in more than one direction has already been changed into conspicuous success; no failure has been accepted as inevitable or irremediable. It may be that this urgent spirit is about to win its greatest triumphs and that, as Mr. Neville Chamberlain suggested at Birmingham on Saturday, a new vista of hope is opening before our eyes. In any case the future is big with possibility, inasmuch as many minds in the scientific world at this time are held in that "emotional tension" from which all progress and discovery proceeds.—*The London Times*.

SCIENTIFIC BOOKS

The Life of Sir Ernest Shackleton, C.V.O., O.B.E. (Mil.), LL. D., with many illustrations. By HUGH ROBERT MILL, Heinemann, Ltd., London, 1923, pp. 312.

THAT truth may be stranger than fiction is occasionally proven in the career of a remarkable man, but seldom more strikingly than in the life of Sir Ernest Shackleton, the Antarctic explorer, whose sudden death so profoundly moved the entire civilized world. This account of his life by Dr. Mill, which is sponsored by Lady Shackleton, if we except the rather dull Part One, which deals with Shackleton's boyhood and youth, is a romance which grips the reader and fastens his attention to the very end.

Even more, perhaps, than others, readers already familiar with Sir Ernest's own narratives of his expeditions ("The Heart of the Antarctic" and "South") will here see the explorer in a new light. In this intimate portrayal by his friend Mill, Shackleton stands out not only as perhaps the best exponent of British pluck and endurance, but as the idealist with a strong passion for poetry—for the lofty sentiments of Browning, Tennyson and Wordsworth even more than for the strong liquor of Kipling and Service. A few stanzas from the hero's favorites have been inserted with rare skill at the headings of chapters. On occasion Sir Ernest wooed the muse himself and not wholly without success, as the following lines show, dedicated to the sailors who were his devoted companions in so many adventures:

> But since that vision left me
> I have looked on those sailor men
> As worthy the brightest idyll
> That poet could ever pen.

The biographer of Shackleton was well chosen, for Dr. Mill is a foremost authority on the history of Antarctic exploration as well as a geographer of distinction, and his intimate friendship for the explorer extended over the entire period of the latter's explorations. Attachment for his friend has not, however, blinded Dr. Mill to the fatal optimism which in Shackleton's business ventures seems to have lacked that fertility of resource held in check by a well-ordered judgment which in his exploring expeditions amounted almost to genius.

As a boy and in early youth Shackleton showed apparently no indication of the remarkable powers which in maturer years were to make him stand forth as one of the dominant figures in all polar exploration, and it is this which accounts for the dullness of the first part of the book. Shackleton was a boy of good ideals, quite religious, and of poetic sentiments. At Dulwich College, which he attended, near his home in Ireland, he made no strong impression either upon his teachers or upon his mates. Returning nineteen years after leaving college to preside at the award of prizes, he delighted the boys when he said that he had "never been so near a Dulwich prize before."

At sixteen Shackleton went to sea as an apprentice, and in the hard life of the sailing ships of the time rose in eleven years to the rank of second mate. Of conscientious scruples and of clean habits, he had little real fellowship with the rough sailors whose respect and even whose love and affection he later commanded in so remarkable a degree. A glimpse of what was in the heart of the young man we learn from something which he wrote when twenty-four:

> I would attain but the goal is that to which Aprile yearned. What can I call success? A few years' praise from those around and then—down to the grave with the knowledge that the best thing has been missed unless the world's success brings that to pass, and for me it seems a long ways off. . . .

Who, from anything recorded in the earlier chapters, would have suspected there was to come the hero who on his first independent polar expedition threw away a portion of the warm clothing so as to carry more food and by a supreme effort in the last étapes pushed nearer the goal; or that here was the leader of the forlorn hope steering a little whale-boat across eight hundred miles of the stormiest seas of the world to achieve the rescue of his party marooned on Ele-

phant Island? Hardly less remarkable was the escape from the drifting floe after the crushing of the *Endurance*. Here the situation called for patience in a leader popularly regarded as impetuous; yet it was he who now played the waiting game in opposition to his party and so saved them when the time was ripe.

In evaluating what was both Scott's and Shackleton's judgment with respect to one important matter, Dr. Mill takes a peculiarly British viewpoint when he says of the party's poor effort in dog driving, "it served to strengthen the fine old British tradition which Sir Clements Markham set such store by, that the best polar draught animals are the human members of the expedition. And in their hearts the *Discovery* people did not believe in dogs." To the reviewer Shackleton once defended the British use of ponies as a substitute for dogs on the ground that their noses were more generally above the heavy drifting snow, ignoring the more important considerations that ponies can not endure the cold, break through the snow, and soon finish, leaving to the human members of the party the heartbreaking work of dragging the sledges at a snail's pace. Fine tradition though it may be, this obsession of British explorers has cost terrible sacrifices. Scott's last expedition proved that the Antarctic summer is too short for men to safely venture to the pole with man-hauled sledges, and Shackleton must have reached the pole on his first expedition had he been fitted out with good dog trains.

The sense of humor which was always keen in Shackleton is well illustrated by a Christmas talk to children. In response to their applause he said: "Now you kids, I'll put you up to a good thing. If you want to see what sledging is like, go home and harness the baby to the coal scuttle and drive round the dining-room table, but don't tell your mother I told you."

After setting out on his last expedition Shackleton wrote:

I love the fight and when things are easy I hate it, though when things are wrong I get worried. . . . I don't think I will ever go on a long expedition again. I shall be too old. [A little later he wrote:] Except as an explorer I am no good at anything. . . . I want to see the whole family comfortably settled and then coil up my ropes and rest. I think nothing of the world and the public. They cheer you one minute and howl you down the next. It is what one is oneself and what one makes of one's life that matters.

WILLIAM HERBERT HOBBS

Silurian. Maryland Geological Survey. Baltimore, The Johns Hopkins Press, 1923, roy. 8vo; 794 pp., 67 pl.

THE Maryland Geological Survey has just published the volume on the "Silurian" of Maryland, the eighth of the series of reports dealing with the systematic geology and paleontology of Maryland. Like the preceding volumes, this is the result of cooperative work on the part of specialists. While there is always the danger of a lack of uniformity in such cooperative undertakings, it also leads of necessity to clarifying discussions among the associates and to an illuminating discussion of problems from somewhat different angles. The latter is, to some extent, also the case in the Silurian of Maryland, for we find on the one hand a careful, conservative description, with numerous sections (largely by W. F. Prouty), of the geographic distribution, geologic, stratigraphic and paleontologic relations, as well as interstate correlation, of the Silurian by C. K. Swartz; and on the other hand a general statement of the American Silurian formation by E. O. Ulrich and R. Bassler, combining the well-known vigorous and incisive criticism of the senior author with the minute, painstaking investigations of the junior author and through this excellent combination furnishing, after much necessary destruction of antiquated views, highly important constructive additions to our knowledge. This is especially apparent in the case of the Clinton formation, which by means of the most detailed study of the Clinton ostracods is divided into a number of zones, the tracing of which into the adjacent state has, so to speak, solved the troublesome Clinton problem for us by establishing reliable datum planes for long-distance correlations. In looking over the many plates of endless species of similar ostracods of the Beyrichia type, one might well think that the limit of refinement in species discrimination had here been reached and passed, but after all the results obtained warrant the outlay of time and money. It is another illustration of the general postulate of biology transferred into faunal stratigraphy, which is that the foundation has first to be laid by unlimited analysis for that final synthesis which is to yield the underlying laws of the biologic procession, as well as of the incessant movements of land and sea in the history of the earth.

The Silurian fauna of Maryland, save the ostracods, is carefully described and illustrated by Swartz and Prouty.

The volume is well illustrated, without being padded, by diagrams, photographs of typical sections and paleogeographic maps (by Ulrich). This new addition to the stately series of Maryland reports is in every way a credit to the state geologist, his collaborators, and to the state which shows its progressive interest and laudable pride in the geology of its territory by this magnificent series of publications.

RUDOLF RUEDEMANN

STATE MUSEUM, ALBANY

SPECIAL ARTICLES

THE PARTHENOGENETIC DEVELOPMENT OF EGGS IN THE OVARY OF THE GUINEA PIG

A RELATIVELY far-going parthenogenetic development of eggs in the ovary of the guinea pig has been observed by us so far in thirty animals. It can therefore not be considered an exceptional occurrence. We observed these ovarian structures, which owe their origin to parthenogenesis, for the first time more than twenty years ago. But owing to their shape and situation, resembling those of ovarian follicles, we believed at that time that they originated in some way in the follicles. Very soon afterwards, however, the suggestion came to us that the structures observed bore a great resemblance to certain embryonal formations, and that, therefore, these bodies might really be due to a far-going parthenogenetic development of the ovum within the mammalian ovary. Definite proof for this interpretation we obtained when, in continuing our search for these structures, we found unmistakable embryonic structures corresponding to neural tube and to other embryonic formations in at least two, and probably in three, guinea pigs. In the large majority of the animals observed, the development proceeds to the formation of embryonal placenta rather than to the development of the embryonal organs proper. We found further confirmatory evidence when we succeeded in producing experimentally extrauterine pregnancy in the guinea pig. It thus became possible to observe eggs embedding themselves and developing in the peritoneal tissue between tube and uterus. In such an embryo developing from a fertilized egg, as well as in the ovarian extrauterine pregnancy which owes its origin to parthenogenesis, a retardation in the development of the embryo and a relative preponderance of placental structures occur, owing to the abnormal conditions under which development takes place. Under both conditions the developing placental structures are of the same character, and giant cells and plasmodia are produced; giant cells migrate into the surrounding tissue and are especially attracted by the blood-vessels; they may substitute the blood-vessel-endothelium and here, in contact with the blood, agglutinate into a syncytial layer. They also may penetrate into the blood stream.

We may assume that in both cases in contact with the host tissue, which is devoid of decidua and under the stimulus of the strange tissue, the early embryonic formations differentiate into placenta rather than into embryonic organs proper. Factors present in the blood-vessels act as a formative stimulus leading to the production of syncytia. There is no structure in the ovary outside of the ovum which can give rise to such formations in the guinea pig; neither the granulosa, nor the theca interna of follicles ever undergo any changes even remotely approaching these parthenogenetic formations. A careful study makes it certain that they are identical with embryonic and placental structures such as are produced in normal and particularly in extrauterine pregnancy in the guinea pig.

These parthenogenetic structures take a cyclic course; they develop through mitotic cell multiplication. After some time the unsatisfactory condition of nourishment, the unyieldiness of the tissue in which they are enclosed prevent their further development. Mitotic growth ceases. The host connective tissue encircles them, presses on them, invades them and thus they gradually disappear.

Not uncommonly hemorrhages occur in the structures just as they occur in the normal placenta. These hemorrhages are due to the ingrowth of blood-vessels into trophoblastic tissue which shows little resistance and to the rarefying action of the wandering giant cells. Furthermore, around the growing embryonic structures hyperemia is found and it seems that the process of ovulation especially is apt to lead to hemorrhages in these fragile tissues. Not only the greater part of the embryo, but even parts of the surrounding ovarian stroma may be destroyed through these hemorrhages. Under no other conditions have we observed hemorrhages of this character in the ovary of the guinea pig.

These embryonal formations develop in young as well as in older animals and especially also in animals which have been kept separated from males. I have observed them in guinea pigs which had not yet ovulated at the time of the development of these embryonal bodies; they may also develop during the latter part of pregnancy and in all these cases we can with certainty exclude a previous fertilization of the ovarian ovum. They, therefore, owe their origin to parthenogenesis.

As many as three embryonic structures may be found in the ovaries of a guinea pig at the same time; these multiple bodies may be situated either in one ovary or in both ovaries. This multiplicity suggests the conclusion that, in addition to local stimuli, some more general condition affecting the animal as a whole favors their development. So far we have not succeeded in producing them at will through various experimental procedures of a physical or physicochemical nature. The embryonic bodies originate in all probability in follicles during the early stages of atresia. At the time of ovulation such an atresia takes place en masse and this may therefore be a specially favorable period for their development; in some cases, however, we can exclude a preceding ovulation in the history of the animal in which they are found, and they must have originated in follicles becoming atretic at other periods of the sexual cycle.

Atresia of follicles may initiate not only processes of maturation in the egg, but also further-going changes which are not of a purely degenerative character, but consist in the formation of mitotic figures other than maturation spindles, and lead to the formation of segments with well-preserved nuclei. Such processes have been observed by ourselves as well as by various other investigators and recently new evidence of the occurrence of early segmentation in ovarian eggs has been brought forward by Newman and by Sansom. Our own findings of far-going parthenogenetic development in the ovarian egg of the guinea pig does not depend for recognition upon the interpretation of these early changes in the eggs of atretic follicles. On the contrary, the more than exceptional occurrence of the parthenogenetic embryonic structures described by us lends support to the interpretation of the changes observed in the eggs of atretic follicles as attempts at parthenogenetic development which in the large majority of cases prove abortive, but which apparently in certain cases overcome the obstacles to a further-going development.

Leo Loeb
Washington University

SUBSOIL ACIDITY

In any forest association the various plants have their rootage systems at different levels in the soil, though for the most part in the upper portion. Secondary roots may be spread over a wide superficial area with an occasional plant sending a tap-root deeper. These relations have been recently reviewed by MacDougall,[1] who also quotes Sherff as stating that plants are able to live together because the main part of their absorbing systems are placed at different levels in the soil.

Study of soil conditions at these various levels, then, is essential to an understanding of physiological behavior and ecological relations of plants growing in the open. One condition is soil acidity, and of subsoil acidity a few studies have been made. Wherry,[2] in New Jersey, dug pits and tested at twenty-five centimeter intervals to a depth of one hundred centimeters, finding a marked decrease in acidity with depth. Salisbury,[3] working at Rothamsted, England, does not tell of his method but finds a decrease in acidity to a depth of thirty inches.

The writer has made borings in areas of soil types found in southeastern Pennsylvania, in all cases in wooded areas and as typical of the whole area as possible. Surface soil conditions have been reviewed in a previous paper.[4]

All sampling was done with a soil auger; an ordinary one and a half inch wood auger fitted with 22-inch joints of gaspipe and a handle which could be uncoupled and carried in the field in a canvas case. Borings could be made to 300 centimeters, but usually bedrock or a cherty subsoil was reached at 100 centimeters or less. Care was taken to keep the auger clean; upon removing it from the boring the outer part of the "core" was scraped off and some of the remainder was pressed into a container. Shell vials were tried but found to be too fragile; seriological test tubes of size 16 × 120 mm. were adopted, being carried in a cloth-lined case in the field. They were marked at 5 cc. and 15 cc. levels, were provided with clean corks and were carefully cleaned in distilled water each time after using.

In the field a sample was tamped lightly with a glass rod to the 5 cc. level and the tube was corked. Being brought to the laboratory (the same day usually, or within twenty-four hours) distilled water was added to the 15 cc. level and the soil was thoroughly stirred. The suspension settling, the extract was tested by the colorimetric method with Clark and Lubs standards of 0.2 pH interval. A simple type of comparator was constructed, using electric light screened by blue glass. Turbid solutions were diluted one half and compared with standards which had corresponding turbid solutions placed before them.

Average pH of Sub-soil Samples

Depth	Hagerstown loam	Chester loam	Manor loam	Dekalb loam	Conowingo loam
S	7.025	6.781	6.480	5.607	5.571
— 15 cm.	6.945	5.793	5,375	5.524	5.421
— 30 cm.	6.859	5.477	5.577	5.599	5.691
— 45 cm.	6.916	6.175	5.850	5.521	6.018
— 60 cm.	7.006	6.293	5.887	5.666	6.218
— 75 cm.	7.070	6.216	5.983	5.750	6.170
— 90 cm.	7.075	6.230	5.733	6.000	6.166
— 105 cm.	7.100	6.233	......	......	......

From tests of over five hundred samples pH values are given in the accompanying table, averaged to the third decimal place. It will be seen that in all cases there is an increase in acidity with depth to 15 or 30 cm., then a gradual decrease toward neutrality. The extent of this variation seems correlated with the productiveness of the soil, being least in the fertile Hagerstown loam.

The relation of these results to plant life, the significance of the variation in pH values with increasing depth, and the relation to microbiotic forms of the soil will be treated in a later paper.

Arthur Pierson Kelley
University of Pennsylvania

[1] MacDougall, W. B., 1922, "Symbiosis in a deciduous forest," *Bot. Gaz.*, v. 73, pp. 200–212.

[2] Wherry, E. T., 1920, "Observations on the soil acidity of Ericaceae and associated plants in the Middle Atlantic states," *Proc. Acad. Nat. Sci.*, Philadelphia, v. 72, pp. 84–113.

[3] Salisbury, E. J., 1922, "Stratification and hydrogen-ion concentration of the soil in relation to leaching and plant succession with special reference to woodlands," *Journ. Ecology*, v. 9, pp. 220–240.

[4] Kelley, A. P., 1922, "Plant indicators of soil types," *Soil Science*, V. 13, pp. 211–223.

Collège de France, and to compare the academic world of Paris with that of Berlin." It is clear enough, on this and other evidence, that Webster did not confine himself closely to the laboratory of Helmholtz or even to the study of experimental physics. He puts himself down in *Who's Who* as having studied during the years 1886–90 at Berlin, Paris and Stockholm. He was four years, instead of the more usual three, in getting his Ph.D. at Berlin, and even so his thesis was, I believe, a philosophical or theoretical disquisition rather than the record of experimental research accomplished. On the other hand, he gained an exceptionally broad and accurate knowledge of the state of physical and mathematical science in Europe, and became remarkably proficient in the use of several languages.[1]

Returning to America in 1890, he became a member of the physics staff at Clark University, then a new institution, as junior to Michelson. His next fifteen years were especially fruitful. Lecturing, from the start, on the higher mathematical aspects of physics, he became, I believe, head of the department and director of the physical laboratory in 1892, when Michelson was called to Chicago. In 1893 he completed an important piece of work, "An Experimental Determination of the Period of Electrical Oscillations,"[2] which won for him, by an award announced in 1895, the Elihu Thomson Prize of 5,000 francs. The details of this event are interesting. Thomson had received, in a competition announced in 1889 by the City of Paris, a prize of 5,000 francs for his watt-meter. He then offered the same amount for a new competition, as a prize for the best work on one of four important problems in electricity. The committee for the award consisted of J. Carpentier, Hippolyte Fontaine, Hospitalier, Mascart, A. Potier and Abdank Abakanowicz. The memoirs were to be presented on or before September 15, 1893, and four were offered, one in German, one in French, and two, numbered at first three and four, respectively, in English. The committee awarded the prize to the fourth paper, with words of especial praise for the author, who proved to be Webster. But number three was considered also worthy of a prize, and ultimately, through the generosity of Professor Thomson and the French and English Thomson-Houston Companies, received also 5,000 francs. This memoir was on the same subject as that of Webster, and was the joint work of Oliver Lodge and R. T. Glazebrook.[3]

[1] In after years he used to address in their own tongue assemblies of Greeks in Worcester.

[2] The paper describing this work is to be found in the *Physical Review*, Vol. 6 (1898) of the First Series, at p. 297.

[3] I have taken this account mainly from SCIENCE, Vol. I (1895), p. 190.

Webster's work in this case was, as he clearly states, an experimental verification of the formula given years before by other men, of whom he mentions Helmholtz and Schiller. It is a good example of the sort of experimental problem toward which he inclined and for which he was, no doubt, best fitted, that is, a problem requiring exact measurements in a field that could be explored mathematically in advance. And to say this is to give him high praise, with the implied admission, perhaps, that he was not a man likely to undertake venturesome explorations or to introduce distinctly new ideas. The following passage taken from his illuminating, and in every way admirable, review[4] of the English edition of Hertz's *Electric Waves*, is relevant here: "The proper order of procedure [in experimental work] may be stated, 'Think, calculate, plan, experiment, think—and first, last, and all the time, *think*.' The method often pursued is: 'Wonder, guess, putter, guess again, theorize, and above all avoid calculation.'" This is good, safe counsel, and probably it was much needed in America at the time it was given, though the world doubtless owes a good deal to the class of unsystematic and usually unsuccessful theorizers who wonder, guess, putter, and guess again.

In 1897 Webster published his *Theory of Electricity and Magnetism*, based upon the lectures he had been giving during six years of teaching at Clark University. This treatise was high above the level of any preceding American text-book in this field, with the exception of B. O. Pierce's *Newtonian Potential Function*, a work of narrower scope, which appeared first in 1886. The book is not, and does not profess to be, new in its subject-matter; it is rather the work of a highly competent and accomplished scholar gladly serving as guide to bring young men into the intellectual company of the great leaders of thought, to whom here as always he rendered loyal, ungrudging homage. The *Preface* ends thus: "If the book shall succeed in clearing up some of the difficulties generally encountered by the student and in inducing him to read the classical writings of Maxwell, Helmholtz, Hertz and Heaviside the object of its author will have been achieved."

In the same year he gave a course of public lectures, on *Electricty* and *Ether*, under the auspices of the Lowell Institute of Boston, no small honor for a man but 34 years old.

In 1899 he took a leading part in founding the American Physical Society, and I believe that he was the initiator of this movement, though I speak subject to correction by those who are more intimately informed regarding the matter than I am. At the organizing meeting, which was held at Columbia Uni-

[4] *Physical Review*, Vol. 3 (1895–6) of the First Series.

versity May 20, he was elected secretary and addressed the assembly in explanation of the call. He was made chairman of the committee chosen to draw up a constitution for the society, and in the permanent organization was made chairman of the council. Rowland was made president, Michelson, vice-president, and Merritt, of Cornell, secretary.

Webster contributed a great deal to the success of the society in its early years. When he did not present papers of his own, he listened diligently to those read by others, a duty occasionally neglected by some of us, and his frequent comments were appreciative and illuminating. Moreover, they were delivered with such vigor, and such evidence of high spirits, that they created a cheerful and lively atmosphere for what might have been, at times, a rather perfunctory and dreary program.

Few men, it seems to me, have so genuinely rejoiced in the nature and achievements of their science as Webster did in physics and the mathematics pertaining thereto. He used to speak of the higher revelations in this field of study almost in the spirit of the old hymn,

> I love to tell the story of unseen things above.

And yet he was not over mathematical in his discussions; for he had what, in a review[5] of J. J. Thomson's *Electricity and Magnetism,* he describes as "the thorough knowledge of mathematics that enables one to express mathematical truths in plain language."

His standing among American men of science after a dozen years of his professional life is well shown by the fact that he was elected a member of the National Academy of Sciences in 1903, at the age of 39, there being at that time, I believe, only two younger members, George E. Hale and Theodore W. Richards.

His *Dynamics* appeared in 1904, and the same general comments can be made on this book that apply to his *Electricity and Magnetism.* In reviewing the *Dynamics,* for the Harvard Graduates' Magazine, I described the author as "one of the best spokesmen for physics and the mathematics most used in physics," and said further that, although at first sight the volume under discussion might appear to be intended for the mathematician rather than the physicist, closer examination showed it to be written with a very lively sense of the objective world. Though printed in English, the book was published by Teubner, of Leipsic, as volume XI in the Series *Lehrbücher der Mathematischen Wissenschaften.*

Webster was, in fact, especially interested in mechanics, and his later research work in general had to do with matters of a mechanical nature, such as the energy of sound waves and the pressure developed in the explosion chambers of guns.

[5] SCIENCE, Dec. 13, 1895.

It is clear that he had done a great deal in his first twenty years out of college. In dealing, very briefly, with the remainder of his life, I can hardly do better than repeat certain paragraphs from a letter I wrote to the Boston *Herald* soon after his death, and which appeared in that paper on May 20: Thus far we discover no hint of impending tragedy in the record of his career, but in the light of what has come at last it is not difficult to see that years ago he began to be, in some measure, the victim of his own gifts and attainments. If there had been some element of wholesome dullness in his make-up, just enough to show him early in life that he must not try to attend all meetings of physicists, understand all papers, and speak all languages, while conducting a research laboratory and teaching all the higher branches of his science in his own university, his early years would have been less brilliant, but perhaps his later ones would have been happier. With the tremendous advances and revolutionary changes that have marked the history of physics during the last two or three decades, the program which he had undertaken became too much for the powers of any man.

He probably saw this at the last, but when it seemed too late to change. He grew somewhat morbid, a state of feeling partly shown and partly masked by his humorous habit in speech and writing. Those who knew him well saw that he was depressed at times, and even despondent, but his physical vigor was so great, his bodily health seemingly always perfect, that no one appears to have realized how dangerously his mind was plunging, under cover of those sometimes extravagant bursts of humor that seemed the evidence of high spirits.

Arthur Gordon Webster was a good fellow, and an upright, blameless man. In thinking, so far as I can bear to think, of what his last days must have been, I recall the words of William James, who had known the depths of despondency, spoken to another man of like experience, "No one has a right to speak of life who has never felt the *fear* of life."

EDWIN H. HALL

HARVARD UNIVERSITY

GAME LAWS FOR THE CONSERVATION OF WILD PLANTS

REFERENCE was made in a recent number of SCIENCE (January 12, 1923) by Dr. Gager to the Vermont law of 1921 in which a list of over forty species of native ferns and flowering plants were specified as protected. The law prohibited general commercial collection of these forms but allowed limited gathering for scientific purposes. By inference, all species not mentioned in that list are considered sufficiently common so that their natural in-

crease may be expected to take care of any demand. As a matter of interest, it may be reported that this law seems already to have produced the desired result. Evidence from both botanical and commercial sources indicates that Vermont has ceased to be open territory for the activities of the collectors of rare plants.

Several other states may be reported as having laws of similar import, already passed or up for consideration. In Connecticut, the interests backing conservation have been instrumental in having rare plants recognized as wards of the state, with special emphasis on the state flower, mountain laurel (*Kalmia latifolia*). As long ago as 1867 Connecticut recorded a statute to protect the climbing fern (*Lygodium palmatum*), then widely sought for home decorations under the name of "Hartford fern." The new statutes, in addition to establishing a protected list of laurel, climbing fern and several evergreens, provide also that shipments of wild plants, legally sold as from private land, must bear definite indication of their source, and that written permission from the landowner must be filed with county officers.

Through the activity of the Fairfield (Conn.) Garden Club, a very attractive and effective pamphlet has been printed for general distribution throughout the state. The author is Mabel Osgood Wright (Mrs. J. O. Wright), and the pamphlet is designed to put emphasis on the use and the proper picking of flowers which are not in danger of extinction. The Connecticut situation has been further dealt with in an article in the *American Fern Journal* (*13*, 56–59, May, 1923) by the present writer, including a complete copy of the Connecticut statutes. This may be obtained reprinted as a leaflet of the Brooklyn Botanic Garden on request to the writer.

California also has a law, specifying general protection for a shrub largely in demand for Christmas decoration, Toyon berries (*Heteromalis arbutifolia*), and, in addition, practically all the wild flowers of Yosemite are protected, particularly the snow plant (*Sarcodes sanguinea*). Maryland has a comprehensive law on its books. Massachusetts proposed last year a law designed particularly to conserve the state emblem, the mayflower (*Epigaea repens*), but this failed of passage. It seems to have been poorly conceived, in part at least, as it provided fine or imprisonment for any sale of the mayflower, regardless of whether the seller had the legal right of ownership.

It needs to be realized that in the preparation of any protective law for rare plants the sharp distinction between animals as the property of the state and plants as the property of the landowner must be recognized. Wild animals, even though they may nest or burrow in one farm, ordinarily pass frequently beyond private boundaries. In the case of the migratory bird, the nation holds title as evidenced in recent laws; some even required international agreement for control. The plant, however, belongs with the land in which it grows, and no restriction may be placed on the farmer's operation of this land, except possibly in the case of weeds or poisonous plants where the police power of the state might be involved. Eventually, through the exercise of this police power, we shall see state control of forests on privately owned land, with definite regulation of methods of lumbering, replanting, etc. Such a law was introduced into the New York State legislature the past session but failed of passage.

A copy of a plant law recently proposed in Illinois has come to hand and seems to comprise in a brief statement all the desirable features of a general state law. Its wording is as follows:

A bill for an act. An act for the conservation of the wild plants of the state of Illinois. Certain plants not to be destroyed or sold—Penalty—

Be it enacted by the people of the state of Illinois, represented in the General Assembly: Any person, firm or corporation who shall, within the state of Illinois, knowingly buy, sell, offer or expose for sale any blood root (Sanguinaria canadensis), lady slipper (Cyprepedium parviflorum and Cyprepedium hirsutum), columbine (Aquilegia canadensis), trillium (Trillium grandiflorum and Trillium sessile), lotus (Nelumbo lutea), or gentian (Gentiana crinita or Gentiana Andrewsii), or any part thereof, dug, pulled up or gathered from any public or private land, unless in the case of private land the owner or person lawfully occupying such land gives his consent in writing thereto, shall be deemed guilty of a misdemeanor, and shall be punished by a fine of not less than $10.00 nor more than $100.00 and costs.

Limitation—Section 4. All prosecutions under this act shall be commenced within six months from the time such offense was committed, and not afterwards.

The twenty-year activities of the wild flower preservation societies and other similar organizations seem finally to be bearing rich fruit. Other recruits are joining. At the last annual convention of the Society of American Florists, held at Kansas City last summer, a communication urging wild flower conservation from the Garden Club of America was favorably received and the florists' organization went on record as supporting conservation. Similar action was taken by the Florists' Telegraph Delivery Association, representing the retailers' interests as the Society of American Florists represents the growers and wholesalers. Individual florists have even voluntarily agreed to refrain from the use of cut laurel in their store work.

The problems to be solved legally seem to be three: (1) The protection of rare forms from commercial collection by plant sellers; (2) increased penalties for sheer vandalism, and the invasion of private and

public property in the neighborhood of large cities; (3) provision for state supervision and enforcement of whatever laws are adopted. Another matter for state action is found in the establishment of increased areas of forest reservation. To be of value in plant protection, such reservations need to be large ranges. Small open park areas established as publicly owned land constitute a greater danger to rare plants than continued private ownership. When the west Green Lake near Jamesville, N. Y., was set aside as a state reservation, the public flocked there by the hundred and carried away most of the fern plants.

Absolute protection in the neighborhood of cities seems next to impossible, except by the establishment of guarded sanctuaries, plots of ground sufficiently large to afford a variety of habitats, where rarities may be maintained much as are valuable paintings, books, etc., under proper curatorial supervision. If the saving of some particular species constitutes an emergency, private initiative will probably be necessary, such as was responsible for the institution of Birdcraft Sanctuary, at Fairfield, Connecticut. An area of about ten acres was surrounded with a boy-proof, cat-proof fence; a competent warden was installed with dwelling inside, and the rare plants of the state are now being accumulated. This little park serves also as an extension of the local school system, and frequent class visits are made.

R. C. BENEDICT

BROOKLYN BOTANIC GARDEN,
BROOKLYN, N. Y.

CERTIFIED METHYLEN BLUE

THE Commission on Standardization of Biological Stains has begun the plan of certifying certain definite batches of different stains that are submitted to it for approval. In every case the certification is issued only for the batch of which a sample has been tested; hence any bottle of stain sold with the commission endorsement may be regarded as being of the same lot as the sample examined by members of the commission for the purposes stated on the label.

The commission is issuing two different forms of label and is giving companies the option of using either on batches of stain endorsed by the commission. One of these forms is to bear on it the name of the stain; the other bears nothing but the certification statement and is to be used in conjunction with a label printed by the manufacturer and approved by the commission. Cuts of these two labels accompany this article. Any other form of certification appearing on bottles of stains must be regarded as a spurious statement, issued by the manufacturer or dealer without consulting the commission.

The different stains are to be taken up in this way one by one. Up to the present time methylen blue is the only one for which actual certification of this sort has been issued. The methylen blue samples submitted for testing by the commission were requested of the manufacturers to come up to the following specifications.[1]

(1) Samples of methylen blue to be considered must be of the so-called medicinal grade. It is expected that they will meet the U. S. P. requirements, but less weight will be attached to this consideration than to those following. In other words, a sample giving satisfactory performance will not be excluded because of failure in some particular to meet these chemical requirements.

(2) Methylen blue for the purpose above specified must contain at least 75 per cent. total color, this to be determined by one of these alternative methods:

(*a*) By measurement of the absorption of light of a solution of known concentration. The extinction coefficient of a solution of 10 parts of dye in 1 million parts of water, when measured in a 1 cm. layer at wave length 660 must equal or exceed 1.35.

(*b*) By reduction with titanous chloride. When reduced by titanous chloride in an atmosphere of carbon dioxide, 1 gram of the dye must consume at least 4.69 cc. normal titanous chloride solution.

(*c*) An alternative volumetric method by means of standard iodine solution is under investigation by the Association of Official Agricultural Chemists and is expected to be made available in the near future.

(3) The methylen blue must have no solvent action on casein. This is to be determined as follows: Prepare two 1 per cent. solutions of this stain, one in distilled water, the other in tap water. Place single drops of skimmed milk on each of two clean glass slides and smear each drop over a surface of about one square centimeter so as to form a very thin film of milk; allow this film to dry without heat or at a temperature not over 60° C., immerse for about a minute in xylol to dissolve the fat, then for the same length of time in alcohol to coagulate the casein. After this immerse one slide in the distilled water solution of methylen blue and the other slide in the tap water solution, allowing them to stand for three minutes; at the end of this period there should be no action of the stain on the casein.

(4) The methylen blue should stain the diphtheria organism in any of the types of solutions ordinarily employed. It should be tested as follows: Prepare three solutions of the stain, one a 1 per cent. solution in distilled water, the second a mixture of three parts saturated alcoholic solution to 10 parts of distilled water, and the third three parts of saturated alcoholic solution to 10 parts of 0.01 per cent. NaOH.

[1] These specifications, so far as they refer to optical properties, are subject to revision in the near future.

Prepare three slides of a fresh culture of a diphtheria organism; stain one slide in each of these three solutions for two or three seconds only, *i.e.*, just as briefly as the stain can be poured on and poured off, and wash each slide immediately. Examined under the microscope all three of these preparations should show deeply stained bacteria with the characteristic metachromatic granules sufficiently distinct to insure accurate diagnosis.

(5) The sample should prove satisfactory for histological use. No exact method for determining this can be given, but the sample must be submitted to one or two experts in histological technic in order to get their judgment.

(6) It must be understood that these standards refer to samples to be used for ordinary bacteriological and histological staining. Special standards for methylen blue used in vital staining will undoubtedly be necessary. These standards, however, have not yet been determined.

Approval for bacteriological and general staining has been given samples of methylen blue submitted by the following concerns:

Dye Stuffs Laboratory Co., Cleveland, O.
Empire Biochemical Co., N. Y. City.
Harmer Laboratories Co., Lansdowne, Pa.
Hartman-Leddon Co., Philadelphia.
National Aniline and Chemical Co., N. Y. City.
Providence Chemical Laboratories, Providence, R. I.

In every case the manufacturer has given assurances that there is a sufficient stock of the batch tested to meet the ordinary demand for several years; the certification applies only to the batch tested. These lots of methylen blue are now on the market by all the companies just mentioned and will soon be obtainable from any supply house. In obtaining them it should always be stated that the methylen blue certified by the commission is desired.

All inquiries concerning the certification or reports of unsatisfactory results with them should be addressed to the chairman of the commission, Lock Box 299, Geneva, N. Y. Further work on methylen blue is already in progress, especially as to the type necessary for certain histological purposes for which the grade represented by these six samples seems to be partly unsatisfactory.

Now that the work on stains has reached a point where certification has begun, it seems appropriate to express acknowledgment to one concern whose assistance has been invaluable from the beginning. The Will Corporation, of Rochester, N. Y., through the personal interest of its treasurer, Mr. R. T. Will, has put much time and facilities at the disposal of the commission, without which the early stages of the work would have been almost impossible. The services of this company have been entirely disinterested, and it has even proved that the work of the commission, in calling attention to the specialists in biological stains, has considerably diminished the sales of the Will Corporation in this line. For this reason a public acknowledgment of their services to the work seems to be the least return that can be offered them.

H. J. CONN, *Chairman,*
Commission on Standardization of Biological Stains

GENEVA, N. Y.

THE AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE

THE PHILOLOGICAL SCIENCES

IN conformity with action taken by the council of the association at the recent Boston meeting, Professor W. A. Oldfather, professor of classics in the University of Illinois, has been asked to accept and has accepted the chairmanship of a special committee to study and report on ways and means by which the association may be able to assist in the progress of the philological sciences. Professor Mark H. Liddell, professor of English in Purdue University, has accepted the secretaryship of this special committee.

Since its birth seventy-five years ago it has been the consistent endeavor of the American Association for the Advancement of Science to foster and coordinate all scientific investigations which have for their end the correlation of observed facts under demonstrable laws. But in 1848 the phenomena of language did not come within the scope of this aim. For language was then generally regarded either as a reflection of metaphysical categories beyond the ken of science, or as an ingenious invention designed to facilitate human intercourse.

Later, when the study of the biological and psychological phenomena that include those of language had become subject to rigorous scientific method, the study of language continued to be popularly regarded as possessing only pedagogical or pedantic value. Its fundamental criteria were supposed to be morphological and practical rather than scientific, and its scientific conceptions were subsumed under the head of comparative philology, or historical grammar.

The organizations which fostered this study have thus developed somewhat independently of the scientific stimulus which is the conspicuous feature of our modern intellectual life. They have hitherto chiefly depended for their growth upon special interests in the classics, or in the Oriental languages and literatures, or in archeology, or in anthropology, or in the practical study of foreign languages.

There is no reason for this isolation. For it is now generally admitted that man's language is subject to laws of development over which he has as little control as he has over those that determine his stature. It is also beginning to be apparent that his skill in employing his language as a developed means of thinking definitely conditions his efficiency in using it as a practical means of communication. Upon this efficiency depends the ultimate value of all human knowledge; for, though the truth of science may be attained in the first instance by forms of thinking in which actual words play an insignificant rôle, the attained truth to become a potent factor in the intellectual life of mankind must be put into those thinking forms which the laws of developing language have determined for it.

It is therefore very desirable that philological science shall become more consciously correlated with the other branches of scientific endeavor.

With these considerations in mind the American Association for the Advancement of Science is endeavoring to mark its 75th anniversary by encouraging a concerted effort on the part of American scholars to stimulate cooperative research in the linguistic sciences, and by inviting those representatives of these sciences whose scientific training gives promise of fruitful endeavor in this field to take a prominent part in its scientific activities. The association already includes in its various sections a considerable number of such persons, whose scientific work is increasingly contributing to the efficiency of the organization. The appended circular has recently been sent to a large number of those who may be interested in the organization of the philological sciences in the association. Suggestions are asked for in this connection, especially in regard to the following points: (1) The best way to advance the interests of American philological science. (2) The most practical method of stimulating research in this field. (3) Assuming these sciences to be represented in a special section of the American Association for the Advancement of Science, the most practical mode of organizing and conducting such a section. (4) Suggestions as to how philology may be advantageously represented at the 75th anniversary meeting of the association, to be held at Cincinnati, December 27, 1923, to January 2, 1924.

BURTON E. LIVINGSTON,
Permanent Secretary

THE PHILOLOGICAL SCIENCES IN THE AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE

The Executive Committee of the American Association for the Advancement of Science at its last meeting authorized a special survey of the philological sciences with a view to fostering philological research as a cardinal feature of the Association's activities. This leaflet is sent to those interested in the philological sciences, with the hope of enlisting their support for this movement.

Philology has long been a field of scientific research whose principles and methods are as clearly formulated and definitely organized as those of chemistry or biology. American contributions to the progress of this science have been conspicuous in their quality and extent. The scientific study of language, moreover, apart from its relation to literature, has played an important rôle in the history of American culture.

The fundamental data of language are also fundamental data in other fields of scientific study. For in its physical aspects language depends upon certain forms of sound-waves which are significant in the determination of its fundamental elements; in its biological aspects it depends upon certain types of organic development which make the production and reception of these stimuli natural to the functional activities of the human species; in its psychological aspects it depends upon the generic sensitivities of the human ear to speech-sound impulses in association with conceptual processes, and upon other psychic reactions induced by them, thus forming the most highly developed function of the individual consciousness; and in its social aspects, once unified and generalized by various groups of peoples, it records in permanent form their developing generic concepts and ideals with a clearness and definiteness not to be found in other records of ethnic activities.

The essential significance of these phenomena is to be ascertained from the scientific study of language itself in its various actual conditions and in its various developmental stages during the period since it has been a matter of record. A clear recognition of their interdependencies and a successful solution of the fundamental problems which grow out of them will surely be facilitated by an organization whose work is closely associated with progress and research in the related fields already well represented in the American Association for the Advancement of Science.

We therefore regard the effort of the American Association for the Advancement of Science to organize and foster research in the philological sciences as being likely to conduce to the advancement not only of philology but of science as a whole.

M. H. LIDDELL,
Professor of English, Purdue University
G. L. KITTREDGE,
Professor of English, Harvard University
C. H. GRANDGENT,
Professor of Romance Languages, Harvard University
W. A. OLDFATHER,
Professor of Classics, The University of Illinois
L. J. PAETOW,
Professor of Mediaeval History, The University of California
A. V. W. JACKSON,
Professor of Indo-Iranian Languages, Columbia University
C. D. BUCK,
Professor of Indo-European Comparative Philology, The University of Chicago

SCIENTIFIC EVENTS

CHEMICAL BIBLIOGRAPHY OF BIBLIOGRAPHIES

A résumé of the literature of the problem in which he is interested is the first need of every research worker in the field of chemistry and chemical technology, as well as in other fields of science. To meet this need it is necessary either to find or compile a bibliography of the subject. Unless the problem is very specialized, or of very recent interest, the chances are that somewhere is a list of references, more or less complete, bearing directly or indirectly upon the topic. To believe that it is *somewhere* is an incentive to the search, but to know *where* it is, is to eliminate the search and arrive at the goal.

Books or articles which are primarily bibliographic are so noted in various abstract journals and indexes and are, therefore, easy to find, but a list of references appended to an article or a book, however valuable or complete, is seldom mentioned in the abstract of the article or the index of the journal, and may be entirely lost as a bibliographic aid.

About two years ago the Research Information Service of the National Research Council enlisted the help of several men in the preparation of a key to scientific bibliographies, each man undertaking to prepare the work in his respective science. The bibliography of bibliographies on geology is now in press and active work is under way in those for chemistry and chemical technology, astronomy and physics.

In the field of chemistry and chemical technology about 6,000 references have already been collected, including separate bibliographies, lists of references appended to articles or books and comprehensive reviews of the literature. This field is so wide and the subjects covered so numerous that the cooperation of the specialists in the various branches would be very desirable. If you, the reader, have references to bibliographies in your special field you will facilitate the completion of this work by sending such references to the compiler of the Bibliography of Bibliographies in Chemistry and Chemical Technology at the National Research Council. Any annotation which you may make on the completeness or value of the references will be appreciated.

Work is being pushed toward the early publication of this bibliography at which time notices will appear in all the scientific and technical journals so that those interested may secure copies.

Clarence J. West

National Research Council,
1701 Massachusetts Ave.,
Washington, D. C.

THE WALTER RATHBONE BACON SCHOLARSHIP

Under the terms of the will of the late Virginia Purdy Bacon, of New York, the Smithsonian Institution was bequeathed the sum of $50,000 to establish a traveling scholarship as a memorial to her husband, Walter Rathbone Bacon.

The secretary of the Smithsonian Institution has recently approved the rules which are to regulate the award of the Walter Rathbone Bacon scholarship for the study of the fauna of countries other than the United States of America. The amount available is the interest on the capital invested (about $2,500 a year), the incumbent to hold the scholarship not less than two years.

Applications for this scholarship, addressed to the secretary of the Smithsonian Institution, should be submitted not later than October 1, 1923. The application should contain a detailed plan for the proposed study, including a statement as to the faunal problems involved; the reasons why it should be undertaken; the benefits that are expected to accrue; the length of time considered necessary for the carrying out of the project; the estimated cost; and the scientific and physical qualifications of the applicant to undertake the project.

The scholarship will be awarded for a term of two years. If at the expiration of the term it is desired to extend the time, the incumbent shall make application a sufficient time in advance, accompanied by a statement as to the necessity for such extension.

All collections, photographs, records and equipment become the property of the institution.

The incumbent shall not engage in work for remuneration or receive salary from other sources than the institution or its branches during the period of occupancy of the scholarship.

W. deC. Ravenel,
Acting Secretary

Smithsonian Institution

A PROPOSED AMERICAN INSTITUTE OF OCEANOGRAPHY

At the meeting of the Regents of the University of California, held on June 19, Dr. T. Wayland Vaughan was appointed director of the Scripps Institution for Biological Research. Although the new director's incumbency dates from July 1, 1923, his work as a member of the United States Geological Survey makes it impossible for him to move to La Jolla and assume actual charge of the institution's affairs until January or February, 1924.

Dr. F. B. Sumner, of the staff of the institution, was at the same time appointed to act as director in Dr. Vaughan's absence.

As bearing on the significance of the selection of a director for the institution, the following from the last annual report of the retiring director, Dr. Wm. E. Ritter, submitted to the president of the university some weeks before the action of the regents, may interest readers of SCIENCE:

An important change of policy to accompany the change of administration has been recommended by the retiring director and favored by the outgoing and incoming presidents of the university.

The recommendation is that the new director be selected with sole reference to the work upon the ocean and its life and that as rapidly as may be without harm to any of the investigations now in progress, the program be made exclusively oceanographic, the understanding to be that both the biology and the physics (physics being understood to include every aspect of the ocean as such) be included in the program on an equal footing. The suggestion is that an Institute of Oceanography be aimed at that shall finally have a scope and character worthy of the Pacific, the greatest of the oceans; and worthy also of the greatness of the United States as a nation and of the State of California. Cognizance is taken of the fact that although the United States fronts extensively upon the two main oceans of the earth on both of which she is vitally dependent, there is not within her domain a single institution devoted to the science of the ocean.

It is recognized that the carrying out of so ambitious a plan would have to be a matter of years so extensive and expensive would be the manning and physical appliances necessary. But when viewed in the light of what has already been accomplished in this domain by the institution during the brief period of its existence, and with the small means at its command; and especially when the whole matter is viewed in the light of what has been accomplished in the same general domain by other instrumentalities in other parts of the world, it is not felt that the plan is unreasonably ambitious. It is confidently believed that under the right leadership something approximating what is suggested can be brought about.

The proposal, it may be said, has been widely discussed with scientific men of the country whose interests are kindred to those here involved, and also with Mr. E. W. Scripps and Miss Ellen B. Scripps, all of whom have endorsed it.

AWARD TO DR. SVEDBERG

IN recognition of his leadership as an international authority on colloid chemistry and his success in the direction of research work at the University of Wisconsin during the past semester, the University of Wisconsin has conferred the honorary degree of doctor of science upon The. Svedberg, of the University of Upsala, at the June Commencement. On presentation of Dr. Svedberg to the president, for the degree, Professor F. L. Paxson, chairman of the Committee on Award of Honorary Degrees, said:

The. Svedberg received his doctor's degree only sixteen years ago, yet to-day his laboratories in the ancient University of Upsala are recognized as the world's most active spot for the study of the formation and properties of colloids. Chemical science has advanced in those sixteen years. It has nearly revolutionized the arts of war; and the needs of war in turn have brought profound changes in the approach to chemistry. From the interactions of the two there is promise that the quiet life of mankind will forever be improved.

During the past semester, as a resident in the University of Wisconsin, Professor Svedberg has brought to his department a fresh scholarship and a new technique. He has continued here that peaceful conquest of his colleagues that has marked his career in Sweden. And the results of his inspiring teaching are already to be seen in a growing disposition to look to this university as a center for the study of the special field that he has mastered and illuminated.

PROFESSOR PAVLOV'S VISIT TO AMERICA[1]

THE three weeks spent in America by Dr. Ivan Petrovitch Pavlov, winner of the Nobel Prize for medicine in 1904, and one of the most distinguished physiologists in the world, have not been pleasant. He was robbed of $2,000 in a train in the Grand Central Terminal, was forced to become the guest of the Rockefeller Institute because of his predicament and then was refused a British visé to his passport because he was a Russian.

As a result, Dr. Pavlov, who will sail to-day on the White Star liner *Majestic*, will not be able to attend the Edinburgh Congress of Physiologists, where his presence was desired by his fellow scientists. With his son, Professor Vladmir Pavlov, he will leave the *Majestic* at Cherbourg under a French visé which was readily granted to him, and after a short stay in France will return to Russia.

Dr. Pavlov is a tall, distinguished looking man, straight despite his 75 years. He left Russia, where he conducts laboratories in Petrograd, to attend the Pasteur anniversary celebration in Paris. He came to this country three weeks ago and after a few days started for New Haven to visit friends. Few persons knew that he was in the country, for if they had he would have been welcomed by scientists here as a celebrated physiologist.

He and his son had hardly taken their seats on a train in the Grand Central Station when three men set upon the old man and snatched from him his pocketbook, containing all their funds, $2,000. The porter and the son attempted to catch them, but were unsuccessful, and the old man and his son left the train, perplexed as to what they should do in their predicament. They finally got in touch with Dr. P. A.

[1] From the New York *Times*.

Levene, of the Rockefeller Institute, and since then have been the guests of the institute.

When Dr. Pavlov attempted to get the British visé to his passport he was told that it could not be done. He was accompanied by Dr. Levene, who explained that Dr. Pavlov was not a Bolshevist, that in fact he was anti-Bolshevist, but the passport bureau of the British consulate maintained that they could not visé any Soviet passport without express instructions. Two visits were made by the Pavlovs and Dr. Levene to the consulate, on Thursday and again yesterday, but without success, the son explained last night.

In his Petrograd laboratories Dr. Pavlov has thirty doctors and other helpers working under his direction. Despite his anti-Soviet beliefs, the Soviet Government has protected him and aided him in maintaining his laboratories because of his scientific research. Recently the Soviet Government published his collected papers and distributed them. In recent years he has studied the psychology of animal instinct and formed theories of sleep and hypnotism. His chief researches deal with the physiology of the heart, secretion of the glands, digestion and the producing of gastric and pancreatic fluid.

SCIENTIFIC NOTES AND NEWS

Dr. William Allen Pusey, emeritus professor of dermatology in the School of Medicine of the University of Illinois, has been elected president of the American Medical Association in succession to President Ray Lyman Wilbur, of Stanford University.

Dr. Charles A. Browne, chemist in charge of the New York Sugar Trade Laboratory, has been appointed chief of the Bureau of Chemistry, to succeed Dr. C. L. Alsberg, now director of the Food Research Laboratory at Stanford University.

Dr. William W. Keen completed fifty years of service on the board of trustees of Brown University on June 21. Dr. Keen, who is 86 years old, left for Europe, following the reading of a resolution, extending felicitations to him.

The Board of Trustees of the University of Chicago has appropriated the sum of five thousand dollars for the expense in connection with the experiment now being conducted at Mount Wilson Observatory, California, by Professor A. A. Michelson, head of the department of physics.

A trust fund for establishing a fellowship in biological chemistry in the College of Physicians and Surgeons, Columbia University, to be named in honor of the founder of that department, Dr. William John Gies, will be presented at its twenty-fifth anniversary. The committee will also present to Professor Gies an illuminated book containing testimonial letters of appreciation from former students, and from friends in this country and Europe.

The gold medal of the Royal Society of Medicine, awarded triennially to a scientist for contributions to the science and art of medicine, has this year been awarded by the council to Professor F. Gowland Hopkins, F.R.S., professor of biochemistry in the University of Cambridge.

Dr. Livingston Farrand, president of Cornell University, was elected president of the National Tuberculosis Association at its recent annual convention in Santa Barbara, Calif. President Harding and Colonel George E. Bushnell, U. S. Army, retired, were named honorary vice-presidents. Memphis, Tennessee, was selected as the next convention city.

Awards for the scientific exhibits at the American Medical Association meeting in San Francisco were made as follows: the gold medal to Dr. Frank Hinman and his associates at the University of California; the silver medal to Dr. Benjamin T. Terry, Nashville, Tenn. Certificates of merit were given to the U. S. Public Health Service; the department of anatomy, University of California, and the League for the Conservation of Public Health of California. The following were given honorable mention: Dr. Hans Lisser, head of the department of endocrinology, University of California Hospital, and Mr. Ralph Sweet, the Mayo Clinic; Dr. Harry J. Corper, Denver; Dr. Robert E. Farr, Minneapolis; Dr. Amedee Granger, New Orleans, and Dr. Irving F. Stein, Chicago.

W. Nelson Smith, consulting electrical engineer of the Winnipeg Electric Railway Company, and John W. Shipley, professor of chemistry at the University of Manitoba, have been awarded the Plummer Medal by the Engineering Institute of Canada, for their two research papers entitled, "The Self-Corrosion of Cast Iron and Other Metals in Alkaline Soils" and "The Self-Corrosion of Buried Lead Pipes."

The council of the Institution of Civil Engineers has made the following awards for papers read at the meetings during the year 1922–1923: Telford medals to Mr. H. W. H. Richards (London) and Mr. E. O. Forster Brown (London); a George Stephenson medal to Mr. Asa Binns (London); a Watt medal to Mr. A. B. Buckley (Winchester); Telford premiums to Mr. W. A. Fraser (Edinburgh), Mr. S. L. Rothery (Calexico, U. S. A.), Mr. Mark Randall (Johannesburg), and Mr. D. E. Lloyd-Davies (Cape Town); an Indian premium to Mr. D. H. Remfrey (Calcutta); a Manby premium to Mr. F. M. G. Du-Plat-Taylor (London), and a Crampton prize to Mr. F. W. Jameson (Kimberley).

DR. B. A. KEEN, head of the physics department of the Rothamsted Experimental Station, has been appointed assistant director of the station.

DR. GEORGES DREYER, C.B.E., F.R.S., professor of pathology in the University of Oxford, has been appointed a member of the Medical Research Council in the vacancy caused by the resignation of Major-General Sir William Leishman, F.R.S., consequent on his appointment to be director-general, Army Medical Services.

PROFESSOR GEORGE HALCOTT CHADWICK, for the past nine years in the department of geology at the University of Rochester, has resigned in order to accept a research position with the Empire Company, at Bartlesville, Oklahoma.

DR. CASIMIR FUNK has accepted a call to organize a department of nutrition in the State Institute of Hygiene in Warsaw, Poland. He sailed on July 13 from Quebec and is planning to stay away two years.

DR. C. N. FENNER, of the Geophysical Laboratory of the Carnegie Institution of Washington, is spending the summer in the Katmai region, Alaska, to continue his studies of the phenomena of the 1912 eruption of Katmai volcano.

OLAF P. JENKINS, associate professor of economic geology, State College of Washington, is making a geological examination of the coals of Skagit County, Washington, for the division of geology of the Department of Conservation and Development. This is a continuation of the work he did in Whatcom County last summer, the report of which is now in the hands of the state printer.

DR. ARTHUR KNUDSON, professor of biological chemistry in the Albany Medical College, sailed from Montreal on July 6 for Edinburgh. After attending the International Physiological Conference at Edinburgh he will travel in northern Europe. In the autumn he expects to return to the University of Cambridge where he will spend several months in study and research.

DR. E. R. DOWNING, associate professor of natural science in the School of Education of the University of Chicago, who has been in Europe the past nine months studying the teaching of science in European schools, has returned.

AT the invitation of the Rockefeller Institute, Dr. Diego Fernández Fajardo of Yucatan will visit New York and the institute.

PROFESSOR JOHN MERLE COULTER, head of the department of botany at the University of Chicago, has been asked by a committee in New York representing a committee of educators in China and a university in Japan to spend six months in Japan and China lecturing at the colleges and universities of those countries. It is expected that he will address audiences of a more popular character as well as bodies of students and teachers. It is expected that Professor Coulter will speak on subjects pertaining to his own special field of study, botany; on larger questions pertaining to science in general; and on the relations of science to religion and civilization.

DR. CHARLES SHEARD, head of the division of ocular and professional interests of the American Optical Company, Southbridge, Mass., gave a lecture on the evening of June 21 before the Mayo Foundation Chapter of the Sigma Xi, Rochester, Minnesota, on "The physiological and pathological effects of radiant energy upon the human eye."

A REPRESENTATIVE meeting was held on June 1 at the Royal Society of Medicine, at which it was decided to establish a memorial to the late Professor A. D. Waller and Mrs. Waller, in the form of a fund to be used for the promotion of scientific research. In recognition of their close association with the London School of Medicine for Women, where Professor Waller succeeded Sir Edward Sharpey Schafer as lecturer in physiology, and Mrs. Waller was first a student and afterwards a member of council, a position which she held to the last year of her life, it was decided that the research fund should be entrusted to, and administered by, the council of that school. A committee was formed to carry out this plan, of which Sir E. Sharpey Schafer is chairman.

WE learn from *Nature* that in order to commemorate the late Dr. W. S. Bruce, the polar explorer, a Bruce Memorial prize has been founded by subscription among his friends and admirers. The prize, which will take the form of a bronze medal and money award, is to be given from time to time for notable contributions to natural science in the nature of new knowledge resulting from personal visits to polar regions. The prize will be open to workers of all nationalities, with a preference for young men at the outset of their careers as investigators.

THE Paris correspondent of the *Journal* of the American Medical Association reports that more than 15 million insignia (tags) were sold, for the benefit of the scientific laboratories, on Pasteur tag day. In the environs of Paris alone, the sum collected reached around 600,000 francs. There were several different forms of insignia, all of them designed by the best artists. The "tag" designed by Maurice Denis represents Pasteur leaning over his work table, examining with a microscope the milk he is taking from various bottles. In the foreground is the figure of a young

mother, seated, with a sick child on her lap, the drawn lines on her face betraying her great anxiety. The man who pushed back death is the theme developed by Paul Albert Laurens. His design represents an angel thrusting back the scythe swung by the skeleton figure draped in white, which has been for centuries the incarnate conception of death. Poulbot designed a vignette which represented a young boy bitten by a mad dog, thus recalling the discovery of the antirabic vaccine. Abel Faivre was content to perpetrate a pun. The scientist is represented with a halo about his head, while beneath are inscribed the words: *Le bon Pasteur* (the Good Shepherd).

CANON WILLIAM WEEKES FOWLER, vicar of Earley, Reading, England, known for his work on the Coleoptera, died on June 3, at the age of seventy-four years.

M. K. LOWEGREN, the first professor of ophthalmology in Sweden, has died at the age of eighty-seven years.

PROFESSOR HEINRICH BORUTTAU, director of the Friedrichshain Hospital, Berlin, known for his work in physiological chemistry, and on the problems of nutrition, died on May 15, aged fifty-four years.

DR. HANS GOLDSCHMIDT, inventor of the Goldschmidt thermite process, died at Baden-Baden on May 21, aged sixty-two years.

THE French Association for the Advancement of Science holds its meeting this year at Bordeaux from July 30 to August 4.

THE New York State Horticultural Society, with a membership of several hundred prominent fruit growers scattered throughout western New York and the Hudson River Valley, will hold its summer meeting on the grounds of the New York Agricultural Experiment Station at Geneva on August 1.

UNIVERSITY AND EDUCATIONAL NOTES

GOVERNOR SMALL has signed the bill appropriating the sum of $400,000 to establish a medical research laboratory at the University of Illinois.

AT the annual commencement exercises of the Northwestern University on June 18, it was announced that $100,000 had been received under the will of Mrs. G. F. Swift, and a like amount from Elbert H. Gary, John C. Shaffer and "A Friend."

A TRAVELING fellowship in medicine has been established at the Cornell University Medical College for 1923–1924 amounting to $2,000. It is available for men and women who have graduated from Cornell within ten years or who are graduates of other medical colleges within ten years who are now attached to the instructing staff of this college. This fellowship has been awarded to Harold Edwin Himwich, who obtained the degree of B.S. from the College of the City of New York in 1915 and the M.D. degree from Cornell University in 1919.

CHARLES W. PUGSLEY, assistant secretary of agriculture, has submitted his resignation, effective on October 1, to accept the presidency of the South Dakota State College of Agriculture and Mechanical Arts at Brookings.

AT their meeting on June 18, the trustees of Cornell University appointed Dr. Robert M. Ogden, professor of education, dean of the College of Arts and Sciences to fill the vacancy which has existed since the resignation of Professor Frank Thilly, professor of philosophy.

RICHARD E. SCAMMON, Ph.D., has been appointed acting director of the department of anatomy of the University of Minnesota during the year's absence of Dr. Clarence M. Jackson, who will serve as chairman of the medical division of the National Research Council during the coming year.

DR. BOWMAN C. CROWELL, of Charleston, S. C., has been appointed professor of pathology in the Jefferson Medical College of Philadelphia, to succeed Dr. William M. L. Coplin, who has resigned.

DR. H. H. WILLARD has been appointed full professor of analytical chemistry in the University of Michigan.

MR. E. C. WILLIAMS has been appointed to the Ramsay Memorial chair of chemical engineering at University College, London. He has been research chemist to the joint research committee of the University of Leeds and the National Benzol Association.

DISCUSSION AND CORRESPONDENCE

PHOTOGRAPHIC PLATES FOR THE EXTREME ULTRA-VIOLET

IN recent years there have been a number of attempts to improve the photographic methods, perfected by Schumann, used in the investigation of the ultra-violet, so far without any very striking results.

Recently Mr. David Mann and I have been making some experiments with the daguerreotype process. The results, though interesting, are so far of no great practical value. It is not difficult to prepare a surface which will be very sensitive in the region about

wavelength 1850 AU, and on two or three occasions we have obtained records extending to wavelength 584 AU, but in general the behavior of the plates in the extreme ultra-violet is capricious and unsatisfactory.

Duclaux and Jeantet (*Journal de Physique*, II, 1921, p. 154) have described a way of "Schumannising" an ordinary dry plate by treating it with sulphuric acid, and recently Aston has referred to the same process. M. Duclaux has been so kind as to send me some specimens of the results he has obtained. He informs me, however, that he prefers another method which he and his colleague have discovered and which was described in their article just cited. His experiments were confined to the region of the spectrum which may be investigated with a quartz prism spectrograph; I have continued them into the extreme ultra-violet.

The procedure is extremely simple. A fast commercial photographic plate—I have employed a "Seed 30"—is coated with a thin film of a colorless paraffin oil; it is then exposed in the usual way in a vacuum spectroscope, the oil is removed with acetone and the plate is developed. The results are nearly, though not quite, as good as those which I have obtained with the most sensitive Schumann plates prepared according to the old method; it is quite easy to get a record of the strong helium line at 584 AU.

The success of the process evidently depends on fluorescent action; I have tried a number of different kinds of oil and I find that "Nujol," a very pure oil sold in this country for medical purposes, yields good results.

I feel sure that this discovery of Duclaux and Jeantet will prove a real blessing to all spectroscopists who work in the extreme ultra-violet.

THEODORE LYMAN

JEFFERSON LABORATORY,
HARVARD UNIVERSITY,
JUNE 28, 1923

THE PHYSICO-CHEMICAL BASIS OF PSYCHIC PHENOMENA

TO THE EDITOR OF SCIENCE: A paper entitled "Physico-chemical basis of psychic phenomena," by Hughes and King, in SCIENCE, May 18, 1923, touches on a problem of the most fundamental importance. For the sake of those who have been unable to follow the literature of nerve physiology I believe that certain comments on this paper are appropriate. The article in question begins with the sentence, "Ever since Galvani discovered the relation between an electric current and muscular action, there has been a feeling among scientists that the nerves are electrical conductors and that nerve impulses are really electrical currents." To a physiologist acquainted with the work of Bernstein,[1] Brünings,[2] Gotch,[3] Lucas,[4] Adrian[5] and Lillie[6] this sentence makes somewhat the same impression that would be conveyed to a physicist by such a statement as this, "Ever since the days of Franklin there has been a feeling among scientists that electricity is the cause of magnetism."

Since the work of DuBois-Reymond and Bernstein the intimate and fundamental relation between the nerve impulse and the electrical disturbance which marks its progress has been known, although not as yet fully understood, much as the intimate relation between electricity and magnetism has been known since the days of Oersted and Faraday. On the other hand the last possibility of explaining the nerve impulse as an electric current along the fiber in the same manner as it is conducted along a metal wire was definitely swept away by the research of Adrian in 1912[5] in which he showed conclusively that the energy of the nerve impulse comes not from the stimulus, but from the nerve fiber itself, thus proving that the nerve impulse belongs to an altogether different class of disturbance from the current in a wire. This fundamental experiment of Adrian's in a somewhat simplified and modified form is now performed as a class exercise by medical students in more than one university in this country. In 1914 Adrian,[5] by a wholly different line of experiment, established the all-or-nothing law for the nerve impulse, not in the sense frequently ascribed to this law, that the impulse is of immutable magnitude under all conditions, but in the sense that it is independent of the strength of stimulus, provided this be adequate, depending only on the condition of the tissue at the moment. These researches were in a sense the culmination of work inaugurated by Gotch and Lucas which had already created strong presumptive evidence pointing towards the conclusion at which Adrian finally arrived. More recent work by Olmsted and Warner[7] has reinforced and extended these conclusions.

The precise nature of the nerve impulse is still unknown, but those properties just mentioned are well established. The principles which have emerged from these researches should not be confounded with speculative hypothesis; they are clearly established facts.

1 "Untersuchungen über d. Erregungsvorgang im Nerven- und Muskelsysteme. Heidelberg," 1871.

2 *Arch. f. d. ges Physiol.*, 1903, xcviii, 241.

3 *Journ. Physiol.*, 1902, xxviii, 395.

4 *Proc. Roy. Soc., B*, 1912, lxxxv, 495; "The Conduction of the Nervous Impulse," London, 1917.

5 *Journ. Physiol.*, 1912, xlv, 389; 1914, xlvii, 460; 1920, liv, 1; 1921, lv, 193.

6 *Physiol. Reviews*, 1922, ii, 1.

7 *Am. Journ. Physiol.*, 1922, lxi, 228.

In view of this, any further attempt to prove that the nerve fiber conducts impulses in the same way that a wire conducts an electric current is merely a waste of time.

I do not mean to imply that the considerations mentioned in the paper of Hughes and King about two-phase systems of immiscible liquids and interfacial tension are not significant. They are doubtless highly significant. A careful study of recent papers by Lillie and Adrian will show the strong probability that the conduction of the nerve impulse depends on a semi-permeable state of the membrane surrounding the fiber and on the electrical difference of potential resulting therefrom. This semi-permeable state of the membrane in turn may probably depend in part on certain features of a two-phase system. Furthermore, experiments with narcotics are among the most likely to throw light on the important problem of the ultimate nature of the nerve impulse, but they should be conducted with due consideration for the great mass of facts already accumulated by a number of the ablest scientists of modern times—facts and principles which have already gone a long way towards giving us a picture of the nerve impulse. The neuropathologists and the psychologists already have something of a basis on which to work; but future research, coordinated with past research, will greatly strengthen this basis. In this work there is room for chemists, physicists and physiologists alike, if their work be properly coordinated.

ALEXANDER FORBES

WHAT IS A WEED?

THE word "weed" is usually defined as a plant growing out of place. This conception is not easily tangible for the following reasons:

(1) An innocent inquirer may think of a plant being out of place, in one or two respects—(a) As out of its natural habitat; for example, Jack-in-the-Pulpit in an open dry field, or, pigweed in a moist shaded forest; (b) As growing where some human being wishes it not to grow; for example, Bouncing Bet in the cabbage patch, or, rye in the wheat field. This latter conception (b) doubtless expresses the virgin idea of the formal definition, "A weed is a plant growing out of place."

(2) If so, we have an odd rule, under which any plant in the universe may instantly become a weed without the slightest change in character, habitat or position. Under this rule, a plant is a weed, not according to specific qualities nor by a definite concept in the mind of any man, but by human caprice; for example, the sugar maple trees become weeds when some man wishes to convert the grove into a corn field.

(3) To say that a weed is a plant growing out of place is to include in the weed realm all obnoxious parasitic plants. This is objectionable for two reasons: (a) In actual practice no person thinks of those dependent plants that cause wheat rust, corn smut, etc., as weeds. However, these species constantly grow where human beings wish them not to grow, but they are *parasites.* (b) A parasite has the definite distinction of drawing its food detrimentally and directly from a host, but to speak teleologically a weed is an honest, independent competitor for food materials in the "struggle for existence."

What seems, therefore, to be a more workable conception of a weed may be stated as follows: "A weed is an independent plant whose species is persistently obnoxious on cultivation areas." The salient words in this statement are "independent species persistently obnoxious," and these four words may be taken as a definition of a weed, as against the salient words in the old definition—"A plant growing out of place." In this new definition all parasites are excluded, and weed-craft is confined definitely to independent species that are repeatedly obnoxious to phytocultural operations.

ELMER GRANT CAMPBELL
PURDUE UNIVERSITY

QUOTATIONS

REWARDS FOR SCIENTIFIC RESEARCH

SHOULD the Canadian Parliament take the action which the Canadian Premier, Mackenzie King, has announced the intention to propose, and award to Dr. F. G. Banting, the discoverer of "insulin," a life annuity of $7,500, it will be an event of importance both in itself and as an example for other nations. [Parliament has unanimously voted the annuity.] Incidentally, it will give convincing proof that the Canadian lawmakers have an intelligent appreciation of a service to the world such as has been rendered by the Toronto physician and an equally intelligent understanding of the best way to reward that service.

Professional ethics as understood among the English-speaking peoples, and most others except the Germans, will prevent Dr. Banting from exploiting the large commercial possibilities of his remedy, and the fame acquired from his achievement will be confined rather closely to his colleagues and will not pay grocers' bills. It is therefore the wisest of generosity for Canada to give to the son whose honors she shares enough to permit the devotion, without material anxieties, of the rest of his life to the form of research for which he has demonstrated his competence. Even though he never should find another specific for one of humanity's scourges, his work is sure to increase the general stock of medical knowledge.

The amount suggested as his honorarium seems large only because such appropriations of public funds are so rare. After all, it is only the interest on $150,000, and, compared with the fortunes made by other inventors—the Fords, the Edisons, the McCormicks and their like—it seems absurdly small. But it is enough, for the needs of the scientific investigator are small and, assured for himself and his family against the necessity of earning a livelihood by immediately profitable work, he will be content—will count himself, indeed, among the luckiest of mortals.

That the action of Canada in the case of Dr. Banting, if taken, will be exemplary, is not too much to hope. It will call world-wide attention to the fact that there are discoveries and inventions which should not be made the basis of a monopoly by the issuance of a patent or copyright, though, on the other hand, they should not be allowed to go unrewarded.

National governments have a duty in this matter, and one which they rarely have recognized. For the most part they have left the maintenance of scientific research to the generosity of individuals or of the few private corporations which have arrived at realization of what "pure science" can do for them. This, however, implies either the acceptance of something very much like charity—the taking of favors for which thanks must be given—or the receipt of a salary that at any moment may cease.

A government, if conducted with sufficient intelligence, would change all this. It would establish facilities for determining just what men had rendered or were likely to render services so widely beneficial that everybody should be expected to pay for them. Then it should make due provision for acquiring a discovery or invention of general benefit and offering it freely to anybody in the country, or in the world, who wants to use it.

Once, at least, our own Congress did just this—it appropriated what it considered a sufficient amount to pay the inventor of "babbitt metal" what that excellent alloy was worth, made its manufacture and use free to all, and so prevented the imposition on all users of a tax continuing as long as a patent would run. If more of this wisdom were displayed, fewer enormous fortunes would be made, perhaps, but that would be no great calamity.—*The New York Times.*

SCIENTIFIC BOOKS

The Mathematical Theory of Probabilities and its Application to Frequency Curves and Statistical Methods. By ARNE FISHER. Vol. I., *Mathematical Probabilities, Frequency Curves, Homograde and Heterograde Statistics.* Second Edition. The Macmillan Company, New York, 1922, pp. xxix + 289.

A Treatise on Probability. By JOHN MAYNARD KEYNES. The Macmillan Company, London, 1921, pp. xi + 466.

THE literature of probability, honorable in the history of science as it is, is not so extensive but that the appearance of two major works on the subject within a year of each other is a notable event. It seems appropriate to review these two books together, because they represent so perfectly what have been, throughout the history of the subject, two diametrically opposed schools of thought about the theory of probability. On the one hand we have the point of view of the person who sees in the theory of probability one of the most potent tools the human mind has ever devised for penetrating deeper into the relations and laws of phenomenal nature. This is the point of view, in short, of the natural scientist who wishes to *use* the theory of probability in the conduct of the practical business of his life in the manner of approach of Laplace, Clerk Maxwell, Willard Gibbs, Karl Pearson and a host of the greatest figures in the history of science. On the other hand is the point of view of the person who regards the theory of probability as essentially only a branch of metaphysics, and finds its usefulness in the fact that it furnishes an entertaining and involved subject to speculate and talk about.

The first of these viewpoints is represented in the book, already well known to statisticians from its first edition, of the distinguished Danish mathematician and actuary, Arne Fisher. It is a sound treatise, of excellent workmanship, on the mathematical theory of probability and its application to practical statistical problems, developed mainly from the standpoint of the Scandinavian school of Thiele, Charlier, etc. It is extremely valuable to have the ideas of this school thoroughly and clearly presented to English and American students, as is done in Fisher's book. Furthermore, there is a freshness and originality in the author's mode of exposition which is highly stimulating and entertaining to the student. Whether the methods and ideas of the Scandinavian school will supplant those of the English school, which derives from Karl Pearson, seems doubtful, so far as concerns American workers, at least. But it is a fine indication of the healthy, vigorous condition of the subject to have these two lines of great activity flourishing at the same time. This second edition of Fisher's book is considerably expanded and improved over the first. It should be in every statistical library. Not the least entertaining feature about it is the commendably vigorous language in which Fisher flays Keynes and tacks his integument up for public inspection and ridicule.

Which may suggest that the present reviewer holds the second book on our list in rather low esteem. Such is in fact the case. Leaving wholly aside, as unimportant, the flippancy, super-smartness and debonair conceit so manifest in the style in which the book is written,[1] the thing which makes it not only an unreliable guide, but in the reviewer's judgment a positively pernicious one for at least that large group of students who wish to make practical use of the theory of probability in scientific research, is its abandonment of the experiential basis of probability, and the substitution in its place of the thesis that the basis of probability is simply a logical relation, independent in respect of its ultimate philosophical validity of any experience whatever. The author rejects completely the possibility of numerically measuring a probability, except in one particular narrowly defined case. The whole thing is essentially a postulational performance. Keynes sets up certain fundamental postulates, which bear no particular relation to any known phenomenal universe, then proceeds to develop a system of consequences of these postulates, and finally takes as the criterion of validity the logical consistency of the resulting system. This process is, of course, well known in mathematics, and has served in some hands and in some fields a philosophically useful purpose. The reviewer *guesses* (he has no intention to waste the time necessary to check over the symbolic logic to prove it) that Keynes's system *is* logically consistent, if the initial postulates are granted. But this is a sterile triumph so far as the application of probability to scientific research is concerned.

Of course the book is not all bad. No book is. I can not resist quoting one passage, which seems destined to become classic, as an example of the author's powers of clear and penetrating thought, subtle reasoning and lucid exposition. It is this (p. 36):

"When we say of three objects, A, B and C, that B is more like A than C is, we mean, not that there is any respect in which B is in itself quantitatively greater than C, but that, if the three objects are placed in an order of similarity, B is nearer to A than C is. There are also, as in the case of probability, different orders of similarity. For instance, a book bound in blue morocco is more like a book bound in red morocco than if it were bound in blue calf; and a book bound in red calf is more like the book in red morocco than if it were in blue calf. But there may be no comparison between the degree of similarity which exists between books bound in red morocco and blue morocco, and that which exists between books bound in red morocco and red calf. This illustration deserves special attention, as the analogy between orders of similarity and probability is so great that its apprehension will greatly assist that of the ideas I wish to convey. We say that one argument is more probable than another (*i.e.*, nearer to certainty) in the same kind of way as we can describe one object as more like than another to a standard object of comparison."

RAYMOND PEARL
THE JOHNS HOPKINS UNIVERSITY

[1] Which leads to such choice remarks as the following (p. 180): "It may, however, be safely said that the principal conclusions on the subject set out by Condorcet, Laplace, Poisson, Cournot and Boole are demonstrably false. The interest of the discussion is chiefly due to the memory of these distinguished failures."

SPECIAL ARTICLES

ON THE EXISTENCE OF AN ANOMALOUS REFLECTION OF X-RAYS IN LAUE PHOTOGRAPHS

SPECTROMETRIC observations[1] upon crystals of potassium iodide have pointed to the existence of strong diffraction effects which could not be explained as "reflections" from any imaginable atomic planes. The positions[2] of these X-peaks, as they have been called, have been defined for various angles of diffraction and their wave lengths determined as equal to that of the characteristic radiation of iodine. Possibly related effects[3] have also been observed in the powder photographs from several metals. Very recently a Laue photograph[4] to show the presence of these anomalous reflections has been offered.

Inasmuch as the existence of such diffractions not obeying established laws must of necessity have a great influence upon the interpretations of X-ray phenomena, the study of their properties becomes of importance. Their failure to appear under the prescribed conditions may have even greater significance. The writer has obtained a number of Laue photographs of potassium iodide and no effect corresponding to these X-peaks appears on any of them.

The X-peaks are supposed[4] to show themselves in a Laue photograph taken with the incident X-rays parallel to a cube face as four *spots* symmetrically placed about the center and lying in the same zone as the (100) and (130) reflections. Their distance from the undeviated image will be[4] one centimeter if the crystal-to-plate distance is 2.5 centimeters. The recorded photograph was said to be produced by an

[1] G. L. Clark and W. Duane, *Proc. Nat. Acad. Sci.*, *8*, 90 (1922).

[2] G. L. Clark and W. Duane, *Proc. Nat. Acad. Sci.*, *9*, 131 (1923).

[3] L. W. McKeehan, *J. Opt. Soc. Am.*, *6*, 989 (1922).

[4] G. L. Clark and W. Duane, *J. Opt. Soc. Am.*, *7*, 455 (1923).

exposure which was too short to register any of the normal reflections.

The writer has prepared Laue photographs with the X-rays passing either parallel to or making small angles with the normal to a (100) face. They have been taken both with a crystal-to-plate distance of 2.5 centimeters and with the more commonly employed distance of five centimeters. Some of the exposures were at least ten times greater than necessary for the detection of the ordinary reflections from crystal faces. Four crystal specimens were used; their refractive index was determined to agree within 0.001 with that which has been assigned to pure potassium iodide.[5] Several voltages were used in the preparation of these photographs. The minimum wave length present was directly determined for a particular experiment (1) by calculating from an analysis[6] of the photograph the wave lengths of the rays giving rise to different spots and (2) by taking, under the same conditions of experimentation, a reflection photograph from a calcite crystal. In some photographs reflections were present from wave lengths as low as 0.23 A. U. (the critical absorption limit for the K-series of iodine[7] is 0.374 A. U.). In no instance was anything found upon the photographs at the points which both the published Laue photograph and the accompanying spectrometer measurements indicate as the locations of the X-peaks. Furthermore the general aspect of the Laue photographs is such that there can be no possibility of a confusion of these X-peak spots with the regular reflections occurring upon good photographs.

Potassium iodide, in common with certain other crystals, of which tin tetraiodide[8] is typical, gives hazy diffraction phenomena which are not to be directly accounted for as reflections from planes in perfectly constructed crystals. These diffractions, though they seem to occupy the same positions in different specimens, are not sharply defined; furthermore they are relatively very weak and occur at much smaller angles of deviation than obtain for the X-peaks. As a consequence it is impossible to identify the two.

These hazy diffractions seem related to the well-known "asterism" phenomenon[9] which shows itself as diffraction stripes passing along principal zones of planes in distorted crystals. A number of crystalline substances which deform readily, among which the alkali halides are conspicuous, will usually if not always show some striping from specimens which have not been subjected to external deforming forces. The observed effects with potassium iodide differ from those with other alkali halides in that, instead of a continuous stripe, the intensity is largely localized. Had it been possible to identify these hazy diffractions with the X-peaks, then a proof that the latter were due[2] to X-rays having the frequency of the characteristic radiation of iodine would have led to the possible explanation that the hazy diffractions arise from resonance iodine radiation.[10]

The writer has reexamined photographs of caesium dichloroiodide;[11] Laue exposures also have been made from a number of other crystals which, containing atoms that could emit their characteristic radiations under the action of the primary X-ray beam, might be expected to show X-peak spots. Among the photographs thus produced were ones from barite, barium nitrate and silver nitrate. On none of these was any evidence found pointing to the existence of other than the normal planar reflections.

More details of these experiments, together with reproductions of Laue photographs, will be published soon in the *American Journal of Science*.

RALPH W. G. WYCKOFF
GEOPHYSICAL LABORATORY,
JUNE, 1923

[5] The writer is greatly indebted to H. E. Merwin for this determination.

[6] R. W. G. Wyckoff, *Am. J. Sci.*, *50*, 317 (1920).

[7] W. Duane, *Bull. Nat. Research Council*, *1*, 389 (1920).

[8] R. G. Dickinson, *J. Am. Chem. Soc.*, *45*, 958 (1923).

[9] G. Aminoff, *Geol. För. Förh.*, *41*, 534 (1919); E. Hupka, *Physikal. Z.*, *14*, 623 (1913); F. M. Jaeger, *Proc. Roy. Soc. Amsterdam*, *18*, 3; F. Rinne, *Ber. Sächs. Akad. Wiss. Leipzig* (Math.-phys. Klasse), *67*, 303 (1915).

[10] G. L. Clark and W. Duane, *Proc. Nat. Acad. Sci.*, *9*, 126 (1923).

[11] R. W. G. Wyckoff, *J. Am. Chem. Soc.*, *42*, 1100 (1920).

THE BIOCHEMICAL SULFUR OXIDATION AS A MEANS OF IMPROVING ALKALI SOILS[1]

THE problem of reclaiming alkali soils, especially black alkali, has been studied at various experiment stations and methods for amelioration of the alkali conditions have been suggested. The methods might be divided into mechanical and chemical. The former consists in either surface washing off of the salts or leaching out. The chemical method consists in treating the soil with gypsum whereby the conversion of the carbonates and bicarbonates into sulfates takes place. Recently Lipman suggested a biochemical method whereby the oxidation of sulfur by microorganisms and the production of sulfuric acid might be utilized in converting the carbonates into sulfates. The advantages of this method over the gypsum method is the difference in the reversibility of the reactions in

[1] The authors share equal responsibility and credit for the work reported.

Paper No. 134 of the journal series New Jersey Agricultural Experiment Stations, Department of Soil Chemistry and Bacteriology.

the respective chemical systems. In the gypsum method a large preponderance of it is necessary to force the desired reactions in one direction and even then reversion will take place. In the sulfur treatment the sulfuric acid produced introduces in the system the unstable carbonic acid which is eliminated from the system and the chances for reversion are reduced to a minimum. The conversion of the black into white alkali does not solve the problem in its entirety, since in some white alkali soils the concentration of the soluble salts inhibits plant growth. A combination of mechanical and chemical or biochemical methods must therefore be practiced, the mechanical method as a rule to follow the others, depending on conditions. The drawback of the leaching method is the fact that alkali soils due to colloidal silicates, or other compounds, and peptization of organic matter are impermeable to water.

The work given below is merely a progress report of an investigation conducted at the New Jersey Experiment Station with the purpose of utilizing the biochemical oxidation of sulfur in reclaiming alkali soils. The study takes up the effect of sulfur application on the physical, chemical and biological structure of alkali soils. The soils under investigation were obtained from the California Experiment Station at Riverside. In texture it is a sandy loam, strongly alkaline, having a pH varying from 8.8 to 9.6. The soda odor is quite pronounced. The carbonates run up to about 500 pounds per acre, calculated as Na_2CO_3, the bicarbonates about 1,700 pounds, calculated as $NaHCO_3$, the chlorides run up to 7,000 pounds, calculated as Cl per acre on the basis of two million pounds of soil per acre. This soil is extremely unfavorable for plant growth not only from the standpoint of its alkali content but even from its chlorine content.

Various applications of sulfur were made running from 2,000 pounds to 6,000 pounds per acre. The sulfur was inoculated with a culture known for its strong sulfur-oxidizing capacity. After 18 days of incubation the soil cultures with 6,000 pounds and 4,000 pounds of sulfur were changed considerably; the capillary rise of water was considerably faster in the sulfur treated than in the untreated cultures. The reaction in terms of pH values went down from a pH 9.0 to 8.0; the carbonates disappeared, the bicarbonates were reduced 66 per cent. This was accomplished by the sulfuric acid produced by the oxidation of 33 per cent. of the sulfur. The bacteria content did not change, although a tremendous chemical change had taken place. After 60 days of incubation the physical condition of the soil was improved considerably, as was demonstrated by the capillary rise and speed of leaching through. The capillary rise in the treated soils was 18 inches in 72 hours, in the untreated only 7 inches. The chemical nature changed but slightly; the bicarbonates still persisted even in the cultures with the highest sulfur application; the oxidation of sulfur decreased in most cultures; still the reaction went down to a pH 7.3. No change in the numbers of bacteria took place. It seems as if the concentration of the different soluble salts, especially calcium, magnesium, sodium and iron, had reached a maximum, inhibiting bacterial activities. To test out this hypothesis some soil cultures were leached after 18 days of incubation and allowed to incubate further. After 48 days the cultures were examined again and a tremendous rise in the number of bacteria took place. While the check had only 400,000 bacteria per gram of soil, some of the sulfur treated had as high as 7 millions. That sulfur oxidation had proceeded again at a reasonable rate and that the physical condition was improved still more was demonstrated by the speed and amount of water leached through. The check after 36 hours had only 80 cc. leached through (400 cc. was applied to all cultures), while the sulfur treated had close to 300 cc. leached through. The checks became waterlogged and allowed no water to pass through. It seems as if the gelatinous-like colloidal silicates and peptized organic compounds produce a sponge-like effect. The reaction of the leachings in the untreated cultures remained the same, while in the treated the pH was approaching 7.0. It was also noticed that in some of the treated cultures some vegetation began to appear.

In connection with the study of treating alkali soils with sulfur several cultures were also made up applying alum at the rate of 40 tons of the crude material per acre as suggested by Scofield. The results seem to indicate that alum does not ameliorate the condition, since the colloids, after being precipitated, come back, leaving the soil practically in the same condition as in the checks. A more detailed analysis of the reactions involved will be given at a later date.

The outstanding features of the investigation may be summed up as follows: (1) Sulfur oxidizes rapidly in the early period of incubation; (2) The acid produced coagulates the colloids, destroying the impermeability of the soils and thus allowing leaching operations; (3) Indications seem to point to the possibility of bringing black alkali soils of the most hopeless character back to productivity by treating with sulfur and following by leaching. The details of the procedure as well as a more thorough understanding of the exchange of ions due to the oxidation of sulfur will be reported later as the data accumulated is tabulated.

J. S. JOFFE
H. C. MCLEAN
NEW JERSEY AGRICULTURAL EXPERIMENT STATION

SCIENCE NEWS

FIRE-SWEPT CITY OF ANCIENT MAN IN TENNESSEE

Science Service

CHARRED and blackened remains of a beautiful prehistoric Indian city, destroyed by fire long before the advent of the white man, but formerly covering an area of 500 acres and defended by a palisaded wall and breastworks more than a mile in length, have been discovered in two bends of the Harpeth River near Kingston Springs, Tennessee, by W. E. Myer, special archeologist of the Smithsonian Institution.

Mr. Myer, who has just returned to Washington after two and a half months' excavation at this ancient site, declared that no other old Indian town in the United States was laid out with such artistic skill as is evidenced in the structural plan of the great mounds of this large fortified place.

On one bed of the river is a great hill which was artificially shaped by the ancient builders from bottom to top. Three wide terraces were built at various levels along this hill, and its original summit was cut away until a level plaza, about 1,000 feet in length and 500 in breadth, had been formed. On this level plaza they had erected a large mound. Around the edge of the plaza and the terraces other mounds had been formed. The sun-baked clay used in the construction of ancient earth lodges was found surrounding the open plaza and along the terraces.

In addition to this great central mound on the bold terraced hill, which formed the most striking feature of the city, there were within the walls five other eminences which had also been leveled into plazas. These yielded many traces of the ancient earth lodges and other evidences of the former inhabitants. The remains of about thirty mounds of various sizes have been found. On the edge of the terraces were the earth lodges of the common people. The sacred temples and council houses and the earth lodges of the chiefs and sub-chiefs had probably been placed on the summits of ten of the largest mounds.

The upstream portion of the ancient city was defended on the water side by perpendicular cliffs of the Harpeth River. On the land side many traces still remain of the ancient breastworks, which extended for about a mile and a half and originally had wooden palisades about 10 feet in length firmly embedded in their tops. These palisades formed a wooden wall which had been plastered on the outside in order to make scaling difficult by an enemy. Along this wall at intervals of about 150 yards were found earth bastions which had formerly supported semi-circular wooden towers. The enemy advancing to attack was therefore subjected to fire from the defenders along the main wall and also an enfilading fire from the warriors in the towers on these bastions. Faint traces of the wooden towers and of the wooden palisades were found. The great length of the wall to be defended indicates that the city must have contained several thousand inhabitants.

All the buildings whose traces were uncovered appeared to have been burned. Under an overturned wall the charred remains of the woven-reed tapestry which had formerly hung on the walls of the building were discovered, and Mr. Myer and his assistants secured plaster casts of this ancient work of art for the Smithsonian Institution. No object of white man's manufacture was found on the site. Everything denoted great age.

Beyond all question this town had been lived in and destroyed long before the coming of the whites into the region, while the Indians who claimed this section of Tennessee stated to the first whites that their Indian forefathers had found these remains lying silent and deserted when they arrived.

The mention of these mysterious mounds in a rare book long since out of print gave Mr. Myer the clue which led to the exploration of the place. An airplane was used to survey and photograph the ancient Indian town site.

ALCOHOL FROM SUGAR

Science Service

GASOLINE shortage holds no terrors for the Hawaiian Islands. Their chief crop, sugar cane, is not only able to supply all the motor fuel needed locally, but also enough surplus to make a worth-while export, should the price of gasoline rise much above its present level.

The manufacture of industrial alcohol from molasses is merely awaiting the demand, according to an extensive report issued by H. P. Agee, director of the experiment station of the Hawaiian Sugar Planters' Association, and W. L. McCleery, assistant sugar technologist of the same institution.

Technical problems, they say, have been solved in a satisfactory way with respect to manufacturing both motor alcohol and stove alcohol for domestic fuel purposes. But at the average prices of gasoline and kerosene for the last five years, extensive production is not an inviting proposition.

One sugar plantation, the Maui Agricultural Company, now has in operation an industrial alcohol distillery which is supplying the needs of 32 trucks, 20 passenger cars and two tractors owned by the plantation and its employees. Five hundred stoves used in the kitchens of the field laborers are also being supplied with fuel from this distillery.

Difficulties incident to the substitution of motor alcohol for gasoline in automobiles are said to have been overcome. Much experimentation was necessary in arriving at the present satisfactory formula, but now there is essentially no difference between motor alcohol and gasoline in facility of starting or general ease of operation. The life of the motor and extent of repairs is not influenced by the new fuel. Automobiles at the Maui plantation, which have been operated with alcohol for

SCIENCE

VOL. LVIII JULY 27, 1923 No. 1491

CONTENTS

SCIENCE: A Weekly Journal devoted to the Advancement of Science, edited by J. McKeen Cattell and published every Friday by

THE SCIENCE PRESS

Lancaster, Pa. Garrison, N. Y.

New York City: Grand Central Terminal.

Annual Subscription, $6.00. Single Copies, 15 Cts.

SCIENCE is the official organ of the American Association for the Advancement of Science. Information regarding membership in the association may be secured from the office of the permanent secretary, in the Smithsonian Institution Building, Washington, D. C.

Application made for transfer of entry as second-class matter to the Post Office at Lancaster, Pa.

THE EDUCATIONAL VALUE OF A UNIVERSITY NATURAL HISTORY MUSEUM[1]

IN President Rea's address before the 1920 meeting of the museums association it is stated that 38 per cent. of the 600 museums of the United States are supported by colleges and universities, and that of this number but five expended $1,000 or more in the year 1910. It is also stated that of this 38 per cent. the great majority are uncared for or ill cared for. With a few notable exceptions this statement is true of the natural history museums of 90 per cent. of the colleges and universities.

The reason for this deplorable condition is not hard to find. A generation or two ago the study of natural history, or "natural theology," centered about collections of natural history material—corals, shells, fossils, minerals, birds, etc.—and taxonomy was considered the *summum bonum* of science. As time passed, the wonderful discoveries in genetics, in evolution, in experimental biology, gradually superseded the previous systematic studies, museum specimens were used less and less, and finally, in many colleges, ceased altogether. The museums were nominally under the charge of a professor of zoology or geology, who gave little time to the care of the material. The collections in these colleges have thus gradually gone from bad to worse, and in many cases the perishable material is now of little or no value.

An instance is recalled that in one museum in a large university a collection of kangaroos had been received and stored in a room on the upper floor of a building, where they remained for a number of years. When examined it was found that moth larvae had eaten away the bases of the hairs and the whole back came off like a blanket when touched. This entire collection was thus completely ruined because of lack of funds to provide a tight case and some one to care for the material. In another university a valuable collection of insects had to be destroyed because of its infestation with dermestes. These examples could probably be duplicated many times.

What, then, is the remedy for this distressing condition which renders so large a percentage of our university and college museums ineffectual and a re-

[1] Contribution from the Museum of Natural History, University of Illinois, No. 30. Read before the American Association of Museums, May, 1922.

proach to the profession? The remedy seems plain—the organization of a separate museum department under the charge of a trained curator in every university and college. Is this possible? I think it is, largely. It is a question of convincing the administrative officers that such a step would materially advance the value of the college in its undergraduate as well as its graduate work. This missionary work must largely be carried on by the American Association of Museums. Think what a powerful impetus would be given to the museum movement if 75 per cent. of the 38 per cent. now ineffective could become effective departments of the institutions in which they now but occupy room probably needed for class rooms.

The problem that first presents itself to one seeking to energize these old museums is, "How can I convince the president or trustees that the museum is of vital importance?" For the question put at once to the enthusiastic museum supporter will be, "Of what value is this material to the curriculum of this college?" And this is but a fair question which we ourselves must answer convincingly. Are the methods in use in the modern public museum of value also in a purely educational institution like the college?

Having had a wide experience of some twenty-odd years as curator of a public museum in a large city and also an experience of some seven years in two universities, the writer feels that he can speak with some degree of authority on this subject. With some modifications, made necessary by the change from a public museum to a university museum, the methods in use in a modern public museum are admirably adapted, even necessary, for use in a college museum, large or small. I wish, in the few moments at my disposal, to indicate concretely how a university museum should develop in order that it may be of value and importance to an educational institution of this kind.

These are the days in which visual education is being preached far and wide. The museum has been a pioneer in the field of visual education, and the big city museum is to-day the best single factor in education through the eye. There is scarcely a subject taught in a college that can not be very materially aided or rendered clearer by a carefully planned and executed exhibit. Sir Edward Flower's epigram that the value of museum exhibits depends largely on the method of their exhibition and the use made of them for the purpose of education is so fundamental that it should be considered one of the basic laws of museum administration.

In order that I may be specific let me outline a few exhibits that are or might be in almost daily use in undergraduate classes. A course in systematic zoology is rendered intelligible only by reference to a well-organized synoptic collection, arranged to show the leading types of the animal kingdom from simple to complex organisms, with an abundance of descriptive labels outlining in more or less simple language the general characters that distinguish one group from another, interesting notes on evolution, distribution or economic use. Maps, diagrams and other illustrative matter should be liberally used. The subjects of evolution, distribution and development can be admirably illustrated by museum exhibits.

Ecology, the modern natural history, can be made both interesting and intelligible by habitat groups, which need not be expensive to be effective. The invertebrates lend themselves more readily to the preparation of habitat characteristics because more profoundly affected by external conditions, and many small vertebrates can be added, so that fundamental principles can be expounded at less expense than by the large and more expensive habitat groups. The group idea is admirably adapted for the presentation of problems in agriculture. These may be of a monographic character, showing, for example, the principal insects affecting corn, grass, fruit, etc. Three such groups at the University of Illinois—corn insects, apple insects, insects in winter—have been found of value to entomology students as well as to the farmers and agriculturists who take short courses in the college of agriculture. A case of local birds is an organic part of a course in ornithology, and during the time of the course students may be seen studying the specimens at different times every day. This exhibit is an integral part of the university curriculum.

Historical geology or paleontology can not be well understood by the undergraduate student without the aid of a well-organized stratigraphic collection in which he may see the actual organic remains described and figured in his text-book arranged in cases in proper relation to each geological period, beginning with the oldest, where he may follow the changes that have taken place during the long period of time since life first made its appearance on the earth. Here he may see a type of animal or plant rise, decline and become extinct, to be followed by another type, often quite different from the first type. In my own museum, half of a large hall is to be devoted to this subject next fall, because so urgently needed.

In modern geography, the museum can be of the utmost value, for here, by the use of models and specially prepared exhibits, the common things of life from all countries may be shown in such a manner as to indicate clearly the relation of various raw materials to present civilization. Thus cotton, steel, rope, paper, buttons, aluminum, petroleum and many other commodities may be graphically exhibited so that the different processes of manufacture may be indicated. Models of physiographic geology may also

be added and will aid in showing how a group of peoples have taken advantage of geographic conditions to aid their social and economic development. Ethnology is but a branch of geography, and by the aid of small groups and actual material the different races or tribes of a country may be made to live again in the imagination. To the college of commerce these exhibits will also prove of value.

The foregoing relates only to the material exhibited in the public halls—the undergraduate side of the museum. But there is another side which must be considered by a strong university—the research or graduate side. Such an institution should accumulate in an accessible manner large series of groups of animals, plants, geological material, etc., for the use of graduate students and for working scientists, both among the faculty and in outside institutions. In this department valuable collections that have formed the basis for formal papers may be carefully preserved for future study. Such material should be cared for by installation in compact drawer cases contained in study rooms away from the museum halls. These collections provide the scientific standing of a university museum.

The question will naturally be asked, Whether the average college can do this? I think it can. Many colleges, of course, are handicapped by lack of funds, and to these the establishment of an adequate museum would be impossible. But there are many colleges and universities in which this department can be established, or, if already established, made stronger. In many cases, public-spirited citizens of wealth would gladly help such a movement if the college museum could be open to the general public and its collections made attractive. I believe that such an arrangement could be made that if the college provided the room, the business men of the town or city would be very willing to bear a large part of the expense of administration of such an enterprise.

I have been asked at different times to indicate the kind of man that is best suited to successfully administer such a department, especially in a college of moderate resources. A curator for this department should, of course, be a man of good education (not necessarily with a doctorate), but above all he should be capable of using both head and hands, with inventive ability, resourceful, and with a pleasing address, working easily in cooperation with other departments. A few such men are available from the ranks of the public museums, but many may have to be especially trained to become college curators.

The items of expense are usually objected to when the subject of a new department is suggested. This need not be great. A good salary for the curator, plus $2,000 per year for development, will accomplish wonders if the curator is of the right sort. Much may be done on less, and greater results will follow larger resources. It would seem possible to establish the kind of museum outlined above in all our larger universities with a relatively small expenditure of money. It is being done at Illinois, and also in some other state universities, and should be in others.

My experience of five years at the University of Illinois has shown conclusively that a modern working museum is a highly desirable part of a large university and that the methods in use in our great public museums are in the main applicable to the needs of the university museum. Most universities are far removed from the large city museum and can not enjoy their privileges. In a university situated as is the University of Illinois, in a small community far removed from the great metropolis, such a place as a museum becomes of wide significance, providing not only material aid for the curriculum but also a place for healthful recreation where the entire student body may go and unconsciously gain knowledge of the great world about them, much of which will be second in importance only to the regular courses they may be taking. It is my purpose at the University of Illinois to show that a natural history museum can be one of the most potent factors in general education.

FRANK COLLINS BAKER
NATURAL HISTORY MUSEUM,
UNIVERSITY OF ILLINOIS

AMPHIOXUS FISHERIES NEAR THE UNIVERSITY OF AMOY, CHINA

THIS note is to announce the discovery of an apparently inexhaustible supply of amphioxus near the University of Amoy. The ease with which these zoologically important little animals are to be obtained here should make them available in practically unlimited quantities for students of biology the world over. It has been my privilege recently to visit the village of Liuwutien,[1] about six miles from the University of Amoy, the source of livelihood of whose inhabitants is the amphioxus fisheries, to make a preliminary investigation of the methods employed in their capture and, as a fitting climax, to partake of a luncheon, several dishes of which consisted in main or in part of amphioxus.

The term fisheries as applied to the capture of amphioxus will no doubt seem strange to zoologists, not so much because amphioxus is not a fish as because of the impression we tend to gather that it has not been found, hitherto at least, in sufficient numbers

[1] Lakotiam in the local dialect.

to justify the use of the term, nor systematically taken for food or other economic purposes. We are most of us wont to see a few specimens at a time, carefully preserved from the rude hands of students. Or, if we have had the experience of dredging for them, as I did some ten years ago in the Philippine Islands, we remember the rejoicings over a few rare specimens obtained. In the present instance, however, because of the great numbers caught and their systematic capture for food purposes, it seems necessary, for lack of a better term, to speak of the industry as the amphioxus fisheries.

So far as I have been able to determine, the industry is as old as the village of Liuwutien, at least several hundred years old—so old that the mind of man runs not to the contrary. The amphioxus fisheries are confined, apparently, to a narrow strip of sea bottom less than a mile wide and extending for about six miles along the coast of the mainland of the Province of Fùkien, South China, immediately behind, *i.e.*, to the north of the Island of Amoy, on which is located the treaty port of the same name and the recently organized University of Amoy. This fishing ground is separated from the island by a narrow strait noted for its strong tidal currents which probably have something to do with making this particular stretch of sea bottom especially favorable for the life of amphioxus.

Here on this little strip of coast about 400 fishermen, using 200 small boats, are engaged for from two to four hours on the ebb tide of every calm day during the nine months from August to April of each year in dredging for amphioxus for the market. The catch per boat is said to average about 10 catties (13 1/3 pounds) a day, while double that amount is taken on especially favorable days. This means a catch of about 2,600 pounds, well over a ton for each calm day during the nine months of the fishing season and a total of hundreds of tons of amphioxus taken during the year!

The larger individuals average about three grains in weight. As a considerable number are under weight an estimate of 2,500 to the pound seems conservative. Counting the number of fishing days as 200 per year and the average daily catch per boat as 13 pounds we arrive at the astonishing total of 6,500,000 individuals in the average daily catch and 1,300,000,000 in the average annual catch. Making deductions for boats out of service, etc., we must conclude that on this little strip of Chinese coast somewhere around a billion amphioxi are caught and consumed each year. If we consider the inefficient and unsystematic method of fishing and the unfailing supply we are led to the conclusion that this strip of sea bottom must harbor many billions of the little animals.

The area to which we are told the amphioxi are limited extends out as far as two li, about 3/5 of a mile, and along the coast for about 20 li, approximately six miles. The actual area of sea bottom involved will be seen to be very considerable, in proportion to the part actually taken up in the dredging operations, particularly, since, so far as we know, the fishing is conducted in a very unsystematic manner, the boats working, much of the time, over more or less the same ground. When, in addition to these facts, we take it into consideration that there is never any failure to obtain the organisms in normal quantities we are forced to believe that the number actually taken is so negligible in proportion to the countless billions present as to make extremely improbable any danger of diminution of their numbers as a result of the industry as now conducted.

If, however, the local fishing rights are weakened and the number of fishermen increased, and more effective and systematic methods of fishing employed, as may well be the case in the future, the fact that gamete-laden amphioxi have such a gritty and unpleasantly fishy taste as to make them quite unpalatable during the spawning season of May, June and July may become an important factor in the preservation of the industry.

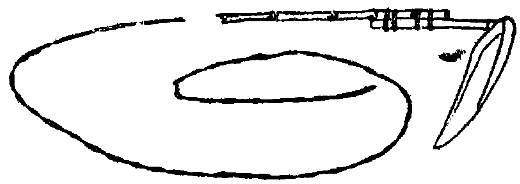


FIG. 1. Dredging apparatus used in the amphioxus fisheries at Amoy, China

The fishing methods and the apparatus used in the local capture of amphioxi while rather primitive are fairly effective. There are two men to each boat, one who sculls and one who manipulates the dredging apparatus. This consists of what appears to be a scoop-shovel blade attached at less than a right angle to a long bamboo (see Fig. 1). To the end of the bamboo is fastened a cable made by twining together two long rattans, to which is spliced another similar cable, the whole reaching a length of from 30 to 50 feet. The dredger stands in the bow of the boat and when fishing grounds are reached, usually in water from two to four fathoms in depth, the dredge is lowered with the blade downwards. When it is resting on the sand the boatman sculls the boat backward for a short distance to bury the blade in the sand. He then sends the boat slowly ahead while the dredger draws in the cable and passes it over the bow of the boat until the bamboo is reached or the apparatus is in a nearly vertical position when it is gently drawn upward and lifted out. The sand brought up on the

blade is dumped into the boat and the operation repeated until a considerable amount of sand containing amphioxi is obtained, when the boat puts for shore to separate the animals from the sand. This is accomplished in shallow water by means of deep, rounded baskets of split bamboo which are whirled about and shaken until most of the sand is washed out through the interstices. The remaining sand, with the amphioxi, is then removed to a much broader and very shallow basket where the final separation is accomplished by the continuation of the process until the animals can be floated off and the remaining coarse sand flipped over the edge.

The inhabitants of the region near the fisheries prize the amphioxus as a dainty. The people of other regions are more or less repelled by its unfamiliar appearance, and hence the greater part of the catch is consumed locally. Emigrants from the locality living in Malaysia purchase a considerable amount of the dried product. The fresh animals remain in an active condition for 12 hours or more after being removed from the water and are available for food for 24 hours or more. They are tender and wholesome and when fresh have a very palatable flavor. No ill effects of any kind are known to follow their use. The economic and social changes now in progress in China will almost certainly result in an increased demand for amphioxus for food purposes. Before any considerable increase in the extent of the industry will be possible the local fishing rights which at present make the industry a regional monopoly must be weakened and of course any such increase would be limited by the actual available supply of the animals which is problematical as yet but seems at least great enough to allow for a very material increase in the catch without appreciably diminishing the supply.

The dried product is prepared by heating the amphioxi after thorough washing in fresh water to drive out the excess salt water, after which they are roasted over a slow fire with a small amount of oil until dehydrated. In this form they are very palatable and keep for several months in the winter and a month or more during the summer. The fresh animals sell for 15 cents Mexican and the dried product for a dollar Mexican in the local markets.

The data given here were obtained for me on our trip of investigation by Dr. Lim Boon Keng, president of the University of Amoy, who kindly questioned the fishermen and other inhabitants and made translation of their answers. Numerous other interesting questions arise as to habits, habitat, structure, physiology and development of this species, some of which I hope to be able to answer in the future. Among these are the actual distribution of the amphioxus in depth and along the coast, and their food, the tidal currents and any other factors which explain their presence in such numbers in this one locality.

It may be of interest to relate here the curious belief of the local inhabitants to account for the presence of these organisms in such numbers at this spot and nowhere else. The name of the lancelet in Chinese is Wen Shen Yü,[2] which being literally translated means "fish of the God of literature" or more idiomatically, "literary composition fish." It is also called "silver spear fish"[3] from its color and its resemblance in shape to the Chinese spear blade and also "carrying pole fish" from its fancied resemblance to the carrying pole of this part of the world which is flattened and tapers towards both ends. The prevalent name, however, is the one first given, which is derived in the following curious manner. The God of Literature of Chinese mythology, named Wen Shen, who was supposed to aid the competitor in the civil service examinations in the classics, at present superseded but at one time all important in China, is supposed to ride about upon the back of a crocodile and is often so pictured. Now, as the story goes, the crocodile of Wen Shen died and the dead body washed ashore and is clearly to be seen only a short distance from the village of Liuwutien in the form of an island known as Crocodile Island,[4] some white rocks at one end of which may be conceived by a stretch of the imagination to be the snout, the wooded portion in the center, the body, and a long sand spit, exposed at low tide, the tail. From this, the carcass of Wen Shen's crocodile, issue the worms or maggots, the amphioxi. And since, forsooth, this is the only dead crocodile of the region there are of course no amphioxi found elsewhere. Lest this may appear to be the strained explanation of some of the local literati allow me to relate my experience with an ignorant boatman while attempting to obtain the animals by dredging just off the sandy beach in front of the University of Amoy, some six miles in a straight line, but more than twice that by water from the seat of the amphioxus fisheries. The boatman whose sampan we hired for the attempt was very curious as to what we were doing and when my Chinese collector explained he threw up his hands in disgust and could hardly be prevented from at once rowing to shore, saying in great contempt for our ignorance of a matter of such common knowledge, "There is no use wasting your time looking for that fish here since there is no crocodile here."

As to the systematic position of the species under consideration I am unable to make any final statement

[2] Wen Shen Yü, locally pronounced *Boon Shiong Hee*.

[3] Yin Chien Yü.

[4] Pien Tan Yü.

in the absence of the necessary literature. That it is a species of the genus *Branchiostoma* seems probable, since the gonads are paired and the metapleural folds meet symmetrically behind the atriopore. It differs from *Amphioxus lanceolatus* as described in the literature at present available to me in several particulars, most strikingly in the presence of somewhere near 25 pairs of oral tentacles or cirri (Fig. 2). Whether or not it is the *Branchiostoma belcheri* reported from Singapore to Japan I am unable to determine, having no description of that species at hand.[5]

I am sending specimens with this note to Professor E. G. Conklin, of Princeton University, with the request that he have it determined and if possible publish the name of the species with this note for the information of zoologists.

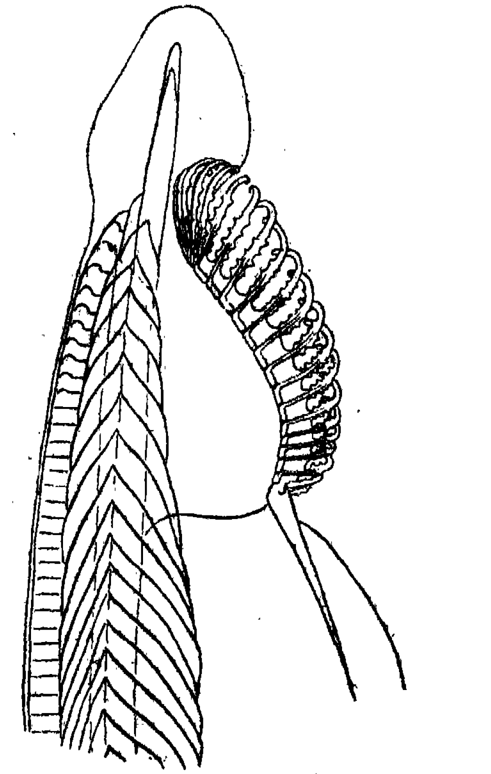


Fig. 2. Anterior portion of body of amphioxus from Amoy showing about 20 oral cirri of the right side, x Ca. 34

[5] Mr. J. T. Illick has examined some of the specimens sent me by Professor Light and finds that there are:
20 ± pairs of cirri
20 ± pairs of gonads (not well developed)
65 ± Myotomes of which 39 are anterior to the atriopore, 17 are between the atriopore and anus, and 9 are post-anal.
He concludes that this species is probably *B. nakagawae*, or *B. belcheri* and these may be identical. (See Cambridge Natural History, Vol. 7, p. 138.) A later note from Professor Light informs me that the species is probably a new one, which he is now engaged in describing.—E. G. Conklin.

The outline drawing of the anterior end of one of the animals discussed in this note and the diagram of the dredging apparatus used in their capture were very kindly made for me by Mr. E. Larsen of the Chinese Postal Service, the former being a tracing from a detailed drawing he is making of the anterior region of a specimen slightly under an inch in length and the latter being a diagram from the apparatus as shown in several photographs which were taken for me on the fishing grounds by Professor H. H. Chang in charge of the department of botany in the University of Amoy.

S. F. Light

Professor of Zoology,
University of Amoy

SEVENTH YEAR OF THE TROPICAL RESEARCH STATION OF THE NEW YORK ZOOLOGICAL SOCIETY

The Tropical Research Station of the New York Zoological Society was founded in January, 1916, after many conferences of Henry Fairfield Osborn, Theodore Roosevelt, Madison Grant and William Beebe. The site chosen was the district immediately around Bartica, British Guiana, in typical tropical rain forest, sixty-five miles from the coast and at an elevation of only twenty-five feet. The station itself is at Kartabo, at the point of junction of the Cuyuni and Mazaruni Rivers, where intensive research work has been carried on in a quarter of a square mile of jungle and shore.

Under the directorship of William Beebe, five expeditions have been made into this field. There have been thirty-two months of actual work, covering every season of the year. Research work at the station has been carried on by twenty-eight workers from America, England, Scotland and France, and two hundred and forty-six visitors have been entertained. One hundred and forty-one contributions have been published, including four bound volumes.

From the limited area under intensive research there have been collected notes, materials and specimens as follows: (1) Life history notes on 75 species of mammals, 451 species of birds, 108 species of reptiles and amphibians, 130 species of fishes; (2) nests and eggs of 152 species of birds, many new to science; (3) skins, skulls and skeletons of 56 species and 650 individual mammals; (4) 1,550 bird skins; (5) 110 bird embryos; (6) hundreds of reptiles, amphibians and fish; (7) 85,000 insects, of which one item is types of 50 new species of termites; (8) 4,500 other invertebrates; (9) 550 KOH specimens;

(10) 2,022 photographic negatives; (11) 22,000 feet of motion picture film; (12) specimens have been supplied to seven universities and five museums, while of living vertebrates there have been collected and sent to the New York Zoological Park 40 mammals, 207 birds and 119 reptiles; (13) the chief collections of amphibians, reptiles and mammals have been presented to the American Museum of Natural History.

It is interesting, in view of this successful prosecution of research work in the tropics, to consider the actual cost of the entire undertaking. From the beginning to the present time the total income has been $49,600. This has included the salary of the director, his assistant and chief artist, the steamship fares, entire scientific outfit, boats, tents, bungalow, household expenses, servants, hunters, taxidermists and the general accommodation for the staff of workers. The five expeditions have averaged six and a half months each, with an average of eight staff members, the total average cost of each trip being $9,920.

THE GALAPAGOS ISLANDS

The seventh expedition of the Department of Tropical Research of the New York Zoological Society was directed to the Galapagos Archipelago, and is known as the Williams Galapagos Expedition. Through the generosity of Mr. Harrison Williams the two hundred and fifty foot steam yacht *Noma* was chartered for the purpose and left March first on a cruise of two and a half months under the direction of William Beebe. The personnel of the party included the regular staff of the Tropical Research Station, Misses Cooper and Rose, Messrs. Tee-Van and Broking, Mr. Hoffman, marine artist, and Mr. Escherich, taxidermist. Four guests of Mr. Williams, Messrs. Curtis, McKay, Mitchell and Merriam, assisted in making collections. Professor William Morton Wheeler joined the vessel at Panama and will contribute to the scientific reports.

A total distance of nine thousand miles was steamed, and the equator crossed eight times. Twenty-one days were spent on the Galapagos Islands. To the living collections of the New York Zoological Park were added nine mammals, twenty-seven birds, and forty-two lizards, notable among which were flightless cormorants, Galapagos penguins and hawks, and giant marine and land iguanas peculiar to the Archipelago and never before exhibited alive. For the American Museum there was collected material for two lizard groups, *Amblyrhynchus* and *Conolophus*, including vegetation, rocks, shells, photographs and sketches, together with a giant tortoise, eighteen lizards and a family of sea-lions.

Among other material gathered were 90 water colors, 400 photographs, 11,600 feet of moving picture film and many thousands of vertebrates and invertebrates. These will be studied by various specialists, while the general account of the trip by William Beebe will be published this autumn in book form by G. P. Putnam's Sons, under the auspices of the Zoological Society.

HENRY FAIRFIELD OSBORN,
President of the Zoological Society

AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE

PLANS FOR THE SEVENTY-FIFTH ANNIVERSARY MEETING

MEMBERS of the local committee for the approaching Cincinnati meeting of the American Association for the Advancement of Science and members of its subcommittees have been named as follows:

Louis T. More, chairman of the Local Committee.
Thomas Quinlan, Subcommittee on Hotels and Transportation.
E. D. Gilman and L. T. More, Subcommittee on Meeting Places.
R. E. Oesper, Subcommittee on Exhibits.
N. M. Fenneman, Subcommittee on General Program.
C. N. Moore and W. H. Bucher, Subcommittee on Publicity.
George Warrington, Subcommittee on Hospitality and Receptions.
H. S. Fry, Subcommittee on Dinners and Society Hotel Headquarters.
E. D. Gilman, Secretary of the Local Committee.
Daniel Laurence, Treasurer of the Local Committee.

Preparations for the meeting are going forward in a very satisfactory way and a very good set of arrangements for serving the various sections and societies has been worked out. The following local representatives for the sections have been named:

Section A, Louis Brand.
Section B, S. J. M. Allen.
Section C, H. S. Fry.
Section D, E. I. Yowell.
Section E, O. C. von Schlichten.
Section F, E. C. Day.
Section G, H. M. Benedict.
Section H, H. McE. Knower.
Section I, B. B. Breese.
Section K, E. E. Eubank.
Section L, E. M. Lostpeich.
Section M, R. S. Tour.
Section N, Henry Page.
Section O, Wendell Paddock.
Section Q, A. L. Hall-Quest.

Each section representative is to act for the special societies in his field and all inquiries and requests concerning sessions, meeting places, etc., from the societies, as well as from section organizations, should

be made directly to the proper section representative or representatives. If societies have named special local representatives other than the local representatives of their section, these special society representatives should consult with the proper section representative in all cases. It is not necessary, however, that the special societies that are to take part in the Cincinnati meeting should name special local representatives. The attention of the secretaries of sections and societies is especially called to this arrangement, which promises to avoid some of the confusion that has sometimes occurred in the preliminary work for past annual meetings.

The Hotel Sinton is to be the general headquarters hotel for the association as a whole. This hotel has promised exceptionally good features and offers attractive prices. It will be able to accommodate a large number of those who will attend the meeting. All rooms are provided with bath and the prices are to be \$3.00–\$5.00 per day for single rooms and \$5.00–\$7.00 per day for double rooms. Headquarters hotels for the several societies are to be arranged for through the local representatives for the proper sections. The Hotel Sinton can accommodate a number of societies and there are other excellent hotels in Cincinnati from among which society headquarters may be selected. Society officers should correspond with their section representative in this regard, as well as in regard to arrangements for sessions. The same plan also applies to arrangements for society dinners and smokers.

The section representatives, who will have charge of all details for the sections and societies, will be in constant and direct communication with the subcommittees and with the general local committee itself, and information of all kinds may be secured by writing to the proper section representative. These representatives and the members of the local committee and its subcommittees are to be addressed in care of the chairman of the local committee, Dr. Louis T. More, University of Cincinnati, Cincinnati, Ohio.

The privilege of reduced railway rates for the Cincinnati meeting has been granted for most of the country, according to the certificate plan, which has been in operation at recent annual meetings. Those going to Cincinnati are to purchase regular one-way tickets and are to secure from the railway agent, when tickets are purchased, one-way certificates properly filled out by the agent. These certificates, upon being properly endorsed and validated in the registration room, will allow their holders to purchase return tickets at one half of the regular rates. Those residing in the Pacific region will this year have this privilege, which has not been available to them for recent meetings.

All sessions of the third Cincinnati meeting will be held in the buildings of the University of Cincinnati and of the Hughes High School, which is situated adjacent to the campus. The council of the association will hold its main meeting on the afternoon of Thursday, December 27, and the meeting will be opened on the evening of that day, under the presidency of Dr. Charles D. Walcott, secretary of the Smithsonian Institution. The main address at this session will be given by the retiring president of the association, Dr. J. Playfair McMurrich, professor of anatomy in the University of Toronto. The second annual Sigma Xi lecture will be delivered on Friday evening, December 28, under the joint auspices of the Society of Sigma Xi and the American Association for the Advancement of Science. The speaker will be Dr. Willis R. Whitney, of the General Electric Company.

The Cincinnati meeting will be specially interesting and important on account of its being the seventy-fifth anniversary of the founding of the association. One of the evening sessions will probably be devoted to the development of American science during the three quarters of a century since the founding of the association. Further details will be announced from time to time in the pages of SCIENCE, and the preliminary announcement of the meeting will be mailed about December 1 to all whose names occur on the association roll at that time.

BURTON E. LIVINGSTON,
Permanent Secretary

SCIENTIFIC EVENTS

MAGNETIC OBSERVATIONS DURING THE TOTAL SOLAR ECLIPSE

SPECIAL magnetic and allied observations will be made at stations inside and outside the shadow belt of the total solar eclipse of September 10, 1923, by the Department of Terrestrial Magnetism of the Carnegie Institution of Washington, and by various coöperating magnetic observatories, institutions and investigators.

The magnetic observatories, either within or near the limits of the eclipse, are: *North of the belt of totality,* Sitka, Alaska; Meanook, Alberta; Tucson, Arizona; Agincourt, Ontario; Cheltenham, Maryland, and Vieques, Porto Rico; *to the south of the belt of totality,* Honolulu, Hawaii; Cuajimalpa, Mexico, and Huancayo, Peru; *while just outside the limits of the eclipse at beginning and ending* are Kakioka, Japan, and La Quiaca, Argentina. Of the observatories, the one at Tucson is particularly well situated, being only about 200 miles from the central path of the eclipse; the maximum obscuration at Tucson will be about 92 per cent. It is planned that the Department of Terrestrial Magnetism will have parties at two stations within the belt of totality to make magnetic and

atmospheric-electric observations, one of these stations being where the Mt. Wilson Observatory party will be located. The United States Coast and Geodetic Survey will have one special party for making magnetic observations within the belt of totality in southern California, and special observations will be carried out at its observatories. It is also hoped that some magnetic and allied observations may be made at a mountain station, for example, Mt. Wilson, where the maximum obscuration will be about 98 per cent.

The general directions of work proposed by the Department of Terrestrial Magnetism, especially with reference to magnetic and atmospheric-electric observations, as also recording forms, will be supplied to any one interested.

LOUIS A. BAUER
J. A. FLEMING
DEPARTMENT OF TERRESTRIAL MAGNETISM,
CARNEGIE INSTITUTION OF WASHINGTON

RUSSIAN BIOLOGICAL INSTITUTES

Apropos of the list of then-existing biological institutes compiled by H. J. Muller during a trip to Moscow and Petrograd in August, 1922, the following information received from Dr. W. Grossmann, of the Permanent Bureau of the All-Russian Entomo-Phytopathological Congress, Petrograd, may add to our meager knowledge as to the now-existing natural history societies in Russia. In reply to a letter containing a list of Russian corresponding societies of the Academy of Natural Sciences of Philadelphia, Dr. Grossmann wrote, under date of December 24, 1922, that the societies listed below exist "up to the present time," and states that "their names are the same," only the word "Imperial" must be omitted where formerly used.

Moscow. Société des Amis d'Histoire Naturelle.
" Moskovskoe Obstchestvo Estestvo-Ispytateley.
Petrograd. Russian Academy of Sciences.
" Botanitcheski Ssad.
" Comité Géologique.
" Musée Géologique de l'Université.
" Russkoe entomologitscheskoe Obstchestvo.
" Société Russe de Géographie.
" Mineralogitcheskoe Obstchestvo.
" Tsentralnaia Fizitcheskaia Observatoria.
" University.
Tiflis. Botanical Gardens.
" Musée du Caucase.

Dr. Grossman regrets his inability to send some Russian publications on entomology, "as our formalities of censorship are very complicated and postal charges very high." I am sure we all agree with Dr. Grossmann's concluding paragraph, "Let us hope that in some not too distant future the circumstances will change for the better."

WM. J. FOX
THE ACADEMY OF NATURAL SCIENCES
OF PHILADELPHIA

PALEONTOLOGICAL FINDS IN MORAVIA

SINCE the constitution of Czechoslovakia as an independent state, intensive work has been carried on, principally under the auspices of the Provincial Museum at Brno (Brünn), in the great system of limestone caverns of Central Moravia. These caverns disclose not only a great wealth and beauty of stalactitic and stalagmitic forms, but they have also yielded to date numerous indications of the presence of early man, and many skeletal remains of diluvial mammals, some of which are in an excellent state of preservation. These remains now include skeletons of a mammoth, of two lions, of a hyena, a Gulo-borealis, five cave bears and no less than sixty fossil beavers. The skeletons of the cave bears are practically complete and will soon form a striking group in the museum. The preservation of the beavers' skulls and teeth is perfect and the series is one of great value.

The work of exploration of these caves, new ramifications of which are being discovered every year, proceeds under the energetic direction of Dr. Karel Absolon, Curator of the Brno Museum.

A. HRDLICKA

NATIONAL RESEARCH FELLOWSHIPS IN THE BIOLOGICAL SCIENCES

THE Board of National Research Fellowships in the Biological Sciences met on June 30 and made the following appointments in addition to those reported in a previous number of SCIENCE:[1]

Herbert Friedmann, Zoology
E. F. Hopkins, Botany
A. A. Roback, Psychology
F. B. Wann, Botany
Alexander Weinstein, Zoology

These fellowships are supported by a contribution of the Rockefeller Foundation and are administered by a special Board of National Research Fellowships in the Biological Sciences, appointed by the National Research Council. The fellowships are open to citizens of the United States and Canada who possess a Ph.D. or its equivalent. They are intended for candidates in the earlier years of post-doctorate work, and are designed to recruit men and women as leaders of research in the universities and research establishments of the United States and Canada.

[1] May 18, 1923, p. 579.

The basic stipends awarded are $1,800 for unmarried fellows and $2,300 for married fellows per annum. These stipends may be increased when there are other dependents or for other cogent reasons.

The fellowships are not granted to any institution or university, but the choice of place to work is left to the fellow, subject to the approval of the Fellowship Board. The appointments are for full time and no other remunerative or routine work is permitted, except that during the college year the fellows may, by written permission of the board, give a portion of their time, in general not more than one fifth (outside preparation included), to teaching of educational value to themselves, or to attendance on advanced courses of study.

The particular individual with whom a fellow wishes to work should, ordinarily, have agreed to accept him, prior to the consideration of his application by the board. It is further required that the fellow be charged no fees or tuition by the institution where he chooses to work.

When the board will next meet has not yet been decided. A meeting in the spring of the year is assured and if the number of applications received justify it, other meetings will be held in the interim accordingly. Applications may be received at any time and will be placed on file for the meeting which follows their receipt. Requests for information and application forms should be addressed to the Secretary, Board of National Research Fellowships in the Biological Sciences, 1701 Massachusetts Avenue, Washington, D. C.

F. R. Lillie

Chairman of the Committee on Biology and Agriculture of the National Research Council

SCIENTIFIC APPOINTMENTS IN THE BUREAU OF MINES

With the advancement of Dr. S. C. Lind, formerly superintendent of the Rare and Precious Metals Experiment Station, at Reno, Nevada, to the post of Chief Chemist and Chief of the Division of Mineral Technology to succeed Dr. R. B. Moore, other changes in the research branch of the Bureau of Mines throughout the country were made. E. S. Leaver, formerly superintendent of the Southwest Experiment Station, Tucson, Arizona, was selected to succeed Dr. Lind as superintendent of the station at Reno. Mr. Leaver was designated as Dr. Lind's successor because of having given his attention for a great many years to problems connected with the metallurgical treatment of the western ores, especially those associated with the cyanide process.

S. P. Howell, formerly of the Pittsburgh Station, who has spent the past year in Arizona studying the mining problems of that State, especially regarding the use of explosives, has been designated as superintendent of the station at Tucson.

During the past year G. St. J. Perrott and S. P. Kinney have conducted an intensive study of the combustibility of coke in blast furnaces. This work will hereafter be conducted by Mr. Kinney in connection with the operation of the experimental blast furnace at the North Central Experiment Station, Minneapolis, and at commercial furnaces in South Chicago, Illinois, and Youngstown, Ohio. Mr. Perrott has been transferred to the Pittsburgh Experiment Station to direct chemical-physical work in connection with the liquid oxygen explosives investigations.

Dr. T. T. Read, formerly chief of the division of information service in the Washington Office, has been transferred to Duluth, Minn., and made superintendent of the North Central Experiment Station. The headquarters of Dr. Read were fixed at Duluth to permit of maintaining a closer contact with the mining phase of the work.

T. L. Joseph has been made assistant superintendent of the North Central Experiment Station at Minneapolis.

Oscar Lee has been transferred from Minneapolis to the Southern Experiment Station, Tuscaloosa, Alabama, and placed in charge of the iron ore beneficiation work under the direction of Dr. W. R. Crane, superintendent of the station.

Dr. W. D. Bonner, who has been employed as a physical chemist at the Pacific Experiment Station, Berkeley, California, has resigned and will return to the University of Utah as an instructor. C. G. Maier, formerly with the department of metallurgical research of the University of Utah, has been appointed to the position at Berkeley made vacant by Dr. Bonner's resignation.

Professor Ernest A. Hersam, of the University of California, who for the past year has studied metallurgical milling problems at the Massachusetts Institute of Technology in cooperation with that institute and with the American Institute of Mining and Metallurgical Engineers, has returned to his former position as an instructor at the University of California.

John Gross, of the station at Reno, Nevada, will go to Cambridge to continue the work which Professor Hersam has been doing.

John Blizard, who has had charge of the Bureau's fuel work at its Pittsburgh Station, has resigned to accept a position with a commercial concern in New York City, where he will be engaged on the design of super-heaters and heat transfer apparatus.

SCIENTIFIC NOTES AND NEWS

DR. A. A. NOYES, director of chemical research in the California Institute of Technology; Dr. T. W. Richards, professor of chemistry in Harvard University, and Dr. E. B. Wilson, professor of zoology in Columbia University, have been elected foreign honorary fellows of the Royal Society of Edinburgh.

DR. C. F. CHANDLER, professor emeritus in Columbia University, has been elected an honorary member of the Society of Chemical Industry, of which he is a past president.

PROFESSOR JOHN MERLE COULTER, head of the Department of Botany at the University of Chicago, has been elected an honorary fellow of the Botanical Society of Edinburgh.

THE University of Strasbourg has conferred on Dr. Jacques Loeb, member of the Rockefeller Institute for Medical Research, the title of doctor *honoris causa* of the university.

PROFESSOR A. EINSTEIN has been elected a member of the Prussian order "Pour le mérite."

DR. L. H. BAEKELAND, of Yonkers, N. Y., honorary professor of chemical engineering in Columbia University, has been made "Officier de la Legion d'Honneur" by the French Republic. Dr. Baekeland is president of the Bakelite Corporation and of the General Bakelite Company and past-president of the American Institute of Chemical Engineers and of the American Electrochemical Society.

PROFESSOR PITRES, neurologist and former dean of the Bordeaux faculty of medicine, has been elected a member of the Paris Academy of Moral and Political Sciences.

DR. R. H. TODD and Dr. W. T. Hayward are the first recipients of a gold medal instituted by the British Medical Association in Australia for "distinguished service." It is to be presented at the congress of the association to be held in Melbourne in November.

DR. EMMANUEL DE MARGERIE, director of the geological map service of Alsace and Lorraine, who has spent several months in the United States, returned to France on the steamship *Paris*, which sailed on July 7.

THE twenty-fifth anniversary of the graduation of Professor F. A. H. Schreinemakers in the University of Leyden on July 7 is being marked by the issue of a special number of the *Recueil des travaux chimiques des Pays-Bas* which will contain more than sixty articles in English, French, German and Italian by colleagues, pupils and friends.

DR. MELVILLE T. COOK, professor of plant pathology at Rutgers College, has accepted an appointment as expert on diseases of sugar-cane at the Insular Experiment Station at Rio Piedras, Porto Rico. Dr. Cook was plant pathologist for the Cuban government from 1904 to 1906.

DR. LELAND E. COFER, of New York City, has been appointed director of the division of industrial hygiene of the State Department of Labor. Dr. Cofer has been an officer in the United States Public Health Service for over thirty years and has served two terms as assistant surgeon general of the United States, a position he was filling when he was assigned by the United States Public Health Service as health officer of the port of New York.

DR. HAROLD HIBBERT, associate professor of applied chemistry at Yale University, is in England and expects to visit cellulose chemists in Europe.

PROFESSOR LESTER W. SHARP, who has been granted sabbatic leave of absence from the department of botany at Cornell University for the first semester of the coming academic year, will spend the late summer and autumn in northern Europe, chiefly at the Universities of Stockholm, Copenhagen and Louvain. He left Ithaca late in July and will return in November.

DR. JOHN A. MILLER, vice-president of Swarthmore College and head of the Sproul Observatory, left on July 13 with several other scientists to observe a total eclipse of the sun on September 10 from a mountain station in Yerbaniz, Mexico. Other members of the expedition include Professor R. W. Merriott and Professor W. R. Wright, of Swarthmore College.

DR. B. KEREKJARTO, formerly of the University of Budapest and last year a lecturer at Göttingen, will be a lecturer in mathematics at Princeton University during the next academic year.

WE learn from *Nature* that at a meeting of the Royal Society of New South Wales, on May 2, the following officers for 1923–24 were elected: *President*, Mr. R. H. Cambage; *Vice-Presidents*, Professor C. E. Fawsitt, Mr. J. Nangle, Mr. E. C. Andrews and Mr. C. A. Sussmilch; *Hon. Treasurer*, Professor H. G. Chapman; *Hon. Secretaries*, Professor O. U. Vonwiller and Mr. G. A. Waterhouse; *Members of Council*, Dr. C. Anderson, Sir Edgeworth David, Mr. W. S. Dun, Dr. R. Greig Smith, Mr. Charles Hedley, Rev. E. F. Pigot, Mr. W. Poole, Mr. H. G. Smith, Professor J. Douglas Stewart and Professor R. D. Watt.

THE *British Medical Journal* reports that a president's gold chain and badge have been presented to the Royal Society of Tropical Medicine and Hygiene by the retiring president, Sir James Cantlie, who was

one of its founders. The chain consists of a number of plaques held together by ornamental links. Each plaque bears, or will bear, the name of a former president. The center link is formed by the initials of the donor surrounded by a laurel wreath. The badge shows a sketch of a mosquito on a shield, with the motto *Zonae torridae tutamen*. The incoming president, Sir Percy Bassett-Smith, was formally invested with the chain by the retiring president at the last meeting of the society.

Professor F. Gowland Hopkins, Cameron prizeman for 1922 at the University of Edinburgh, delivered two lectures on June 27 and 28, respectively, on the present position of the vitamin question. The Cameron prize, which was founded in 1878, is awarded annually to an investigator who in the course of the five years immediately preceding has made an important addition to practical therapeutics.

Dr. Stephen Sheldon Colvin, professor of education at Teachers College, Columbia University, a leader in educational psychology, died suddenly on June 15 at the age of fifty-four years.

The Board of Estimate of the City of New York has unanimously voted to erect a school service building four stories in height, which is to be placed in the west courtyard of the American Museum of Natural History, at an estimated cost of $733,000. It will include a basement, fully equipped for the distribution of educational material to schools and will be connected by a subway with all other sections of the museum. The basement is also planned to take care of visiting classes that come from a distance from out of town schools. The first floor is designed for the general subject of the natural history of man, showing the relation of man to his environment; also for public health and food exhibitions, including a memorial alcove to Louis Pasteur. The center of this floor is designed for normal school work. The third and fourth floors are designed for practical normal school and college instruction in smaller rooms and for the preparation of the photographic and museum materials which make the round of the schools. The city was moved to make this appropriation by the rapid increase in the use of the museum by the schools, which now reaches four million pupils annually, a figure equivalent to five contacts with each of the 900,000 children now enrolled in the schools of Greater New York.

According to the London *Times* the British Medical Association has purchased the premises in Tavistock Square, Bloomsbury, known as the Theosophical College. It is a modern building, designed by Sir Edwin Lutyens, whose plans were never fully completed, as the building was taken over by the government at one time. It is understood to be the intention of the British Medical Association, for whom Mr. J. A. Phillips (Oxford street) acted as agent, to enlarge and adapt the building as their headquarters. Tavistock Square, on the east side of Gordon Square, has changed in character, like all the Bloomsbury squares in recent years, from being purely residential, and in its early days it had many distinguished literary and other residents, among them Charles Dickens. The neighboring Russell Square has become mainly a center of professional and other organizations, one of the first to settle in that square having been the Auctioneers' and Estate Agents' Institute, now about to transfer its headquarters to a new building in Lincoln's Inn fields. If the project for placing the headquarters of the University of London on "the land behind the British Museum" matures there will be a further aggregation of societies in that district.

The *Geographical Journal* writes: "An undertaking of considerable interest has been organized by the newly founded Scientific Expeditionary Research Association in the form of a scientific expedition to the Pacific, which will leave Plymouth towards the end of September. Free passages will be provided for students of the various branches of science in which investigations are desirable, their expenses being covered in large part by receipts from paying guests, for about twenty of whom there will be room in the vessel chartered—the *St. George*, a three-masted barquantine fitted on the lines of a yacht, with 800 h.p. auxiliary steam engines. It is proposed to use the Panama Canal route both going and returning, and to include in the itinerary the Galapagos, Easter and Pitcairn islands, the Austral and Cook groups, Tahiti and the Marquesas, with various intermediate islands. Although the scientific objects of the expedition may perhaps be hampered to some extent by the need to consider the requirements of the non-scientific members, the project seems to offer an excellent opportunity to young men who have just qualified in the various branches of science to acquire experience and first-hand knowledge of remote parts of the world, otherwise not easily accessible to study.

From a report in the *Journal* of the American Medical Association we learn that at the sixth session of the League of Nations health committee, at Paris, May 26, the development of inter-governmental cooperation in public health matters was discussed as regards epidemiologic intelligence and public health statistics, a regular and rapid method for distributing information has been installed. Three committees were formed: the first, to investigate the prevalence of epidemic (lethargic) encephalitis and tuberculosis in tropical Africa since the World War; the second, to investigate the quantity of opium and other habi-

forming drugs required annually by the various nations for legitimate purposes, and the third to collect information for a conference among various European states having navigable inland waterways, for the purpose of coordinating and strengthening sanitary control, without interfering with the normal functions of the waterways. A report was made of research work conducted in laboratories scattered all over the world during the last eighteen months, aiming at an international standardization of serums. A similar program was proposed in regard to insulin, digitalis and pituitary extract. Public health courses are being conducted for public health officials in Warsaw, Kharkov and Moscow under the auspices of the health organization of the league, and, by an arrangement with the Soviet Russian delegation at the Genoa conference, the members of the health committee, together with a delegate from the central health authorities of Soviet Russia, constitute a special international commission for discussing the anti-epidemic campaign as it affects Russia.

THE Hancock Life Insurance Company, Boston, has made an additional gift of $20,000 to the Harvard Cancer Commission; $5,000 to be used for purchase and installation of a diagnostic apparatus and $15,000 to be placed in the permanent fund. The insurance company previously gave $30,000 toward the building of the Huntington Hospital, which is devoted exclusively to cancer cases. The new gift will be used in the biophysical laboratory, which is also under the direction of the commission.

THE Langenbeck-Virchow Haus, built for the headquarters of the German Surgical Society and the Berlin Medical Society, has been rented to the Siemens and Halske firm for a period of ten years, with the provision that the societies shall continue to have the use of the building for meetings.

DR. KLEIWEG DE ZWAAN, of the University of Amsterdam, has instituted a triennial prize of 2,500 francs to be awarded for research in anthropology.

UNIVERSITY AND EDUCATIONAL NOTES

MRS. NORMAN BRIDGE, wife of Dr. Norman Bridge, professor emeritus of Rush Medical College, has subscribed $100,000 to the fund provided by Mr. Frederick H. Rawson for the Rawson Memorial Laboratory to be built in connection with the medical work of the University of Chicago on the West Side of Chicago. The fund donated by Mrs. Bridge will be used to provide the Norman Bridge Pathological Laboratories which are to occupy the fifth floor of the Rawson Memorial Laboratory.

DR. GEORGE SCATCHARD, associate professor of chemistry at Amherst College, has resigned, being the tenth Amherst college teacher and the fourth alumnus of the college to withdraw from the faculty because of the dismissal of Dr. Meiklejohn. Professor Scatchard explains his resignation in the following statement to President Olds: "After the loss which the college has sustained, it no longer seems possible to accomplish here the purposes for which I came to Amherst."

AT the University of Chicago, Dr. Harvey Carr has been promoted to a professorship of psychology; Dr. Arno Benedict Luckhardt to a professorship in physiology, and Dr. Fred Conrad Koch to a professorship in physiological chemistry.

DR. JOSEPH W. ELLIS, formerly of the University of California at Berkeley, has been appointed instructor in physics in the University of California, Southern Branch.

PROFESSOR JOHN SMITH DEXTER has been appointed associate professor of biology at the University of Porto Rico.

DR. THOMAS JONES MACKIE, professor of bacteriology at the University of Capetown, has been appointed Robert Irvine professor of bacteriology in succession to the late Professor James Ritchie.

DR. P. J. DANIELL has been appointed to the Town Trust chair of mathematics at the University of Sheffield.

DISCUSSION AND CORRESPONDENCE

NOTE REGARDING THE ANNUAL VARIATION OF ATMOSPHERIC POTENTIAL-GRADIENT

MY attention has been called to Dr. Sanford's article in SCIENCE of May 25, 1923, pages 616–618, in which he attempts to account theoretically for the annual variation of the atmospheric potential-gradient. Every student of atmospheric electricity will welcome any suggestion for the solution of some of the outstanding questions of atmospheric electricity, but evidently Dr. Sanford did not have before him the latest observational facts, and so his theory is based on erroneous premises.

In connection with various studies during the past two years on the interrelations of terrestrial magnetism and atmospheric electricity, I have had occasion to examine every available series of observations concerning the atmospheric potential-gradient, made during the past 40 years, from the Arctic to the Antarctic regions. A different type of annual variation is found than that premised by Dr. Sanford. The

latter states that "this gradient should accordingly be greater in winter than in summer, and it should vary in some manner with the altitude of the sun." He then attempts to reproduce theoretically the annual variation of the potential gradient, on the basis that it *"must vary as the sine of the angle of the sun's declination from the vertical at any given place."* He accordingly obtains a type of annual variation of the potential gradient varying from place to place, and of opposite character for two corresponding parallels in the temperate zones, north and south, which does not correspond with observational facts. However, it should be noted first that what Dr. Sanford calls in Figs. 1 to 4 the "Solar Declination" is not the sun's declination as used in astronomy, but the *sun's zenith distance* at apparent noon. No curve, the ordinates of which vary with the sine of the sun's declination, would be reversed in passing from the North Hemisphere into the South Hemisphere at the same time of year.

The outstanding fact disclosed by the annual variation of the atmospheric potential-gradient is that it is not chiefly a local but primarily a worldwide phenomenon and, hence, does not vary according to the sine of the sun's zenith distance at apparent noon at any given place. The available data reveal the following general types: Type *a*—from the Arctic regions to about parallel 33° North and from about 40° South to the Antarctic regions, the maximum potential-gradient occurs near the December solstice and the minimum near the June solstice; type *b*—in the region from about 33° North to 40° South, or over about half of the earth's surface in the lower latitudes, the majority of the stations show a reversed annual variation to that of type *a*, hence, maximum potential-gradient near June solstice and minimum near December solstice; type *c*—in region for *b*, or between *a* and *b*, there are certain stations showing a mixed type of *a* and *b*. On the average, from the Arctic to the Antarctic, the annual range of the potential-gradient is about 60 per cent. of the average potential-gradient for the year; the data in the North Hemisphere seemingly indicate that the range decreases as the region for type *b* is approached.

It turns out that Dr. Sanford was so unfortunate as to select for comparison with his computed curve in Fig. 3 a station, Melbourne, Australia, which falls in the region of type chiefly *b*. At a station in greater southerly latitude than Melbourne, for example, at Cape Evans (77°.6 South; 166°.4 East of Greenwich), where Dr. Simpson, while connected with the Scott Antarctic Expedition, obtained a year's series of observations from 1911 to 1912, the same type (*a*) of annual variation of the potential-gradient is found as for a station in the same latitude north. It is accordingly incorrect to describe the annual variation of the potential-gradient as varying with the season. The variation is of the same type at the same time of year in moderate and high latitudes north and south of the equator, namely, the maximum gradient occurring near the December solstice and the minimum gradient near the June solstice.

Dr. Sanford would be unable by his theory to explain the annual variation of the atmospheric potential-gradient at the station, Helwan, Egypt (latitude 29°.9 North; longitude 31°.3 East of Greenwich), where eight years of observations, 1907–1914, show that the minimum gradient occurred in December and the maximum in July. Helwan falls in the region of type *b*; Dr. Sanford's theory would prescribe an annual variation for this station reversed from that actually observed. There are some indications that the bounding parallels between regions of types *a* and *b* will be found to be magnetic parallels, rather than geographic ones.

The main facts of the annual variation of the atmospheric potential-gradient could apparently be explained by a system of vertical electric currents similar to those which are caused by the translatory motion of an electrically-charged sphere through the ether; for example, the charged earth during its orbital motion about the sun. This hypothesis is at present under investigation.

Fortunately, before long we shall have available additional data in the region of reversed type *b*. The Department of Terrestrial Magnetism has at present two observatories which could hardly be more favorably situated for important contributions to our knowledge concerning terrestrial magnetism, atmospheric electricity and earth-currents in equatorial regions; these observatories are: Watheroo, Western Australia (latitude 30°19′ S; longitude 115°53′ E), and Huancayo, Peru (latitude 12°03′ S; longitude 75°20′ W).

LOUIS A. BAUER
DEPARTMENT OF TERRESTRIAL MAGNETISM,
CARNEGIE INSTITUTION OF WASHINGTON

CASTS VS. CYLINDROIDS

AFTER examining a large number of specimens of casts and mucin from urine under the ordinary microscope and then under the modern dark field microscope (ultra-microscope), it seems to us that dark field examination will probably prove to be a quick and certain method for distinguishing between the two, especially in doubtful cases.

The new method of examination has, so far, revealed marked differences in the ultra-structure of these entities, the mucin showing a faint and extremely fine reticulated ultramicroscopic structure, whereas casts show a much brighter and coarser structure, which is visible even in hyaline casts.

We are continuing this work, and hope to report later, giving photomicrographs, and showing as well the appearance of casts and mucin in the dark field, after they have been acted on by reagents, stains, etc.

JEROME ALEXANDER
JOHN M. CONNOLLY

50 EAST 41ST ST.,
NEW YORK

THE STANDARD POUND

IN the letter of Mr. Alexander McAdie, published in SCIENCE on February 23 ultimo, under the heading "The Depreciation of the Pound," Mr. McAdie states that the provisions of the Corn Sales Act of 1921, effective January 1, 1923, and prescribing that sales of grain, seeds and potatoes in Great Britain shall be by weight only and in terms of the *hundred-weight of 112 pounds*, have the effect of reducing or depreciating the pound from 7,000 to 6,250 grains weight. This is upon the gratuitous assumption that the absolute weight of a hundred pounds or of 700,000 grains is by the Act to be divided into 112 parts to produce a new or "depreciated pound" of 6,250 grains weight. If one were to indulge in assumptions as to the effect of the Act, it would be more legitimate to argue or conclude that the effect of the Act is to divide the absolute weight of 112 pounds or 784,000 grains which constitute the English hundred-weight, into 100 parts to produce an appreciated or enlarged pound of 7,840 grains. But there is neither need nor excuse to indulge in assumptions as to the English *hundred-weight*, because the *hundred-weight*, as specified in the Act of 1921, and as otherwise defined by law, and as long established by custom, consists of 112 standard pounds of 7,000 grains, and is divided into 8 stone of 14 standard pounds. The Act merely declares and confirms the custom of England and establishes uniformity of practice throughout the realm. It imparts nothing new as to the value of the standard pound or as to its division into 7,000 grains, as legally recognized and established in both the United Kingdom and the United States.

The English use and will, under the Act of 1921, continue to use precisely the same pound as the Americans. We, however, use a *hundred* of 100 standard pounds, whereas the English use a *hundred-weight* of 112 pounds. The Englishman wants to divide his *hundred-weight* into 8 equal parts. He can not divide the cental of 100 pounds into 8 equal parts, and he therefore persists in using the *hundred-weight* of 112 pounds, which he can divide into 8 equal parts, each of which he calls a stone. But he nevertheless uses the same standard pound which is used in the commerce of the United States, and certainly no American would deny him the privilege or right to use the *hundred-weight* of 112 pounds, if for reasons which satisfy him, he finds it preferable or convenient to do so, just as the Englishman has no objection to the use of the cental of 100 pounds in Canada, in the British Dominions and in the foreign trade of the Empire.

SAM'L RUSSELL

WASHINGTON, D. C.

APPLIED SCIENCE AND SCIENCE APPLIED

"To be an industrial psychologist one must first of all be a psychologist." "Hardly more than one or two men are earning a livelihood in industry to-day as *psychologists*" (W. V. Bingham). These sentences appear in a modest advertisement of "psychology as a life work" in SCIENCE for April 13.[1] The writer of them believes that "industrial psychology" offers to men with psychological training and possessed of certain assets a career among "fascinating practical problems." The "three outstanding assets for a career" are named by him as "a sound training in scientific method," genuine interest in "all sorts of people and the personality to deal effectively with them," and, finally, "superior practical judgment, especially where money values are concerned." When these assets produce an "output of cash value to industry" they may be expected to bring proportionate "financial rewards." It is exceptional, however—as it appears—for an industrial psychologist to earn a living *as a psychologist*.

In the same article "educational psychology" is declared to show "an increasing demand for experts in psychological and educational measurements." Here "the most necessary qualifications are listed as "general scientific ability, knowledge of educational practice, industry, adaptability and good sense" (E. L. Thorndike). Again, "clinical psychology," which offers to suitable persons opportunities "not surpassed financially," etc., is said to demand acquaintance with the facts of disease and of treatment as well as the "physician's mental attitude" (S. I. Franz). And, in more general terms, "for those who possess the requisite qualities and training there is no limit [in "applied psychology"] to public service and financial rewards" (R. Dodge).

Does this announcement by "experts" persuade the reader that there are "applied psychologies"? Does it not rather call attention to the well-attested fact that scientific knowledge and training may be found to be useful (provided the individual meets certain other requirements) in many practical tasks far removed, in spirit, problem and point of view, from psychology or from any other single science? The article makes it abundantly evident that, where these

[1] SCIENCE, 1923, lvii, no. 1476, pp. 429–431.

tasks relate to such "human endeavors" as medicine, education and business, psychological preparation may be important.

The great public loathes definitions; but it is apt in affixing labels. It has—without any prompting from "science"—stuck the label "psychology" on hypnotism, mind-reading, ghosts, communion with the dead and a dozen magical and medical formulas. From clinical theorists it has eagerly learned to apply the same tag (with "new" prefixed) to the shocking practices of the psychoanalyst. And it has been frequently instructed of late to use the label for various jobs undertaken in business and in the schools by persons whose academic or professional training has included studies of psychology, in tests and in the Pearsonian statistics.

The more seasoned sciences and arts still have their "boundary disputes," but they do not insist that every performance of the scholar or the artisan be set down to the credit of a science or profession. The surgeon skilfully carving the family roast is not doing surgery; nor the zoologist eliminating bad stock from his private herd, zoology; nor the botanist in his lettuce-bed, botany; nor the embryologist, turning an extra penny in the poultry-yard, embryology. Why should psychologists encourage the impression that anything which concerns "human nature" is psychology; that psychology covers the field of "human experience, behavior and personality," or that it is whatever the student of psychology seriously undertakes? What would become of zoology if it professed to compass all of man's varied interests in life, or of physics if it similarly extended its present domain?

The war has shown us how many things beside the concern for his own science or art a trained or skilled man may, when occasion offers, usefully turn his hand to; but we are still tempted to confuse—at least in the case of psychology—the subject and its outside uses, applied science and science applied, the tasks of the science and the man trained by the science applying himself to extra-psychological tasks. The confusion is natural in the great public, which labels but does not define: it is inexcusable in the spokesman or the zealous apologist for the science.

Madison Bentley

University of California

SCIENTIFIC BOOKS

Outline of Psychology. By William McDougall. New York, Charles Scribner's Sons. 456 pages.

McDougall's "Outline of Psychology" offers a marked contrast to the numerous psychological texts that have appeared recently in America. Other system-writers, almost without exception, recognize the validity of the physical "cause-and-effect" relation in the realm of mental phenomena. Professor McDougall expressly denies the possibility of interpreting the sequence of mental events as "a mechanical chain of cause and effect," and asserts that the fundamental category of psychology is "purposive striving" (p. vii).

As explained in the preface, the present volume does not attempt to set forth in sequence the principal facts and laws of the science; it is a carefully constructed train of reasoning, designed to demonstrate the truth of the author's teleological concept, which he terms the hormic theory (p. 71). Viewed in this light, rather than as a systematic treatise, there can be no question but that the book fulfills its purpose remarkably well. The fundamental thesis is definitely stated at the outset and the supporting arguments are marshaled point by point throughout the book.

After outlining the alternative theories and indicating the difficulties of the mechanistic position, the author proceeds to examine the characteristics of animal behavior. He cites Jennings's example of the amoeba in pursuit of a smaller amoeba and the latter's ultimate escape to prove that even in the simplest known creatures behavior is essentially purposive. In successive chapters the behavior of insects, lower vertebrates and mammals is examined with the same result. Especial stress is laid on the fact that an instinct is not a mere grouping of reflexes but a unified act which serves to accomplish some definite purpose in the animal's life history.

The transition to human psychology is somewhat marred by a chapter (VII) entitled "Behavior of the natural man," which speculates upon the behavior of an assumed non-social being, "Mowgli," somewhat after the fashion of the eighteenth century social contract literature. This is the only departure from the empirical method. The remainder of the book is taken up with a detailed examination of man's mental activities, such as attention, imagining, emotions, disposition and temperament, and belief, concluding with the growth of intellect in general and the organization of character. Throughout these successive stages the purposive nature of mental activity is emphasized; the organism's behavior is portrayed as a constitutional *striving* to attain an end, dimly foreseen in the lower species, distinctly pictured in the higher human realm. This *conative* tendency is coupled with the *cognitive;* the two together complete "the description of mental activity in its double aspect of knowing and striving" (p. 266).

As already stated, McDougall's work is radically opposed to the general trend of American psychology. Contemporary writers for the most part accept the causal principle in what McDougall would call its mechanistic form. They assume that the activity

the nervous system, including the brain, is describable in terms of physicochemical processes, and that the principles or modes of mental activity are in some manner closely related to the modes of neural activity. Even the radical behaviorist, in denying the scientific character of the "mental," merely emphasizes the supremacy of "natural law." To McDougall, on the other hand, mental activity belongs to a distinctly different type from inorganic activity. Organic behavior does not follow the resultant of forces—it pictures the future and operates to attain a desired end.

The teleological theory offered in this book is closely related to the vitalistic theory in biology. Each assumes a mode of activity distinct from the strictly causal sequence of events—a factor which somehow guides the flow of energy and determines the outcome. It is precisely at this point that the teleological conception is open to challenge. The arguments of Driesch for an organic entelechy have been seriously questioned by leading biologists. Similarly, Professor McDougall's colleagues will question his teleological interpretation of response. The present volume offers no suggestion as to the *manner* in which the hormic activity works. The author merely states that the end is foreseen and that the activity proceeds till the purpose in view is accomplished. But is this true? Certainly the adult who has endeavored to twitch his ears without prior training finds that the purpose to accomplish this result does *not* attain the appropriate goal, no matter how intense or prolonged the striving. And so with the lower types of behavior. "Instinctive activity," says McDougall, "strives toward a goal, a change of situation of a particular kind, which alone can satisfy the impulse and allay the appetite and unrest of the organism" (p. 119). In pre-Darwinian days the instincts might well have been defined in these teleological terms, but natural selection indicates an alternative explanation —evolution of traits by racial "trial and error"— which seems both intelligible and plausible. Such questions of fact and interpretation will have to be thoroughly threshed out before the real value of McDougall's work can be determined.

Perhaps the weakest point in the present volume is the author's vagueness in defining his fundamental concepts. The reader will ask for a more lucid description of *striving, conation* and *foresight* than is given. There is also throughout the book a certain dogmatic insistence upon the cardinal doctrine of teleology, coupled with an all too frequent use of the adjectival method of refuting opponents. ("Loftily assert," p. 28; "impossible," "obviously absurd," p. 84; "fantastic theories," p. 128; "lofty attitude," p. 194; "the extravagant behaviorist doctrine," p. 289.)

On the other hand, the evidence for non-mechanistic activity is ably presented and deserves careful and unprejudiced study on the part of investigators, to whatever school they may belong. Professor McDougall's formulation of the hormic theory (p. 71–3) raises teleology from metaphysical speculation to a real psychological problem, and his explanation of the nature of free-will (p. 46–8) gives that time-worn theory a new meaning.

Of special interest is the discussion of the seven marks which the author believes distinguish the behavior of organisms from the physicochemical activities of inorganic matter (pp. 44–46, 56). These are: (1) spontaneity of movement; (2) persistence of activity; (3) variation of direction of persistent movements; (4) termination of the activity when a particular change in situation is brought about; (5) preparation for the new situation; (6) improvement in the effectiveness of behavior; and finally (7) the fact that "purposive action is a total reaction of the organism," rather than a specific reflex or group of reflexes. These characteristics, taken together, afford perhaps the best synthetic view of the teleological conception of behavior.

HOWARD C. WARREN

PRINCETON UNIVERSITY

Historia de la Influencia Extranjera en el desenvolvimiento Educacional y Cientifico de Costa Rica. Por LUIS FELIPE GONZALEZ. Imprenta Nacional, San José de Costa Rica, 1921. 8vo, pp. (6) + XI + 320, 24 plates, each containing four portraits.

THE title of this clearly printed volume accurately describes its contents, which are concerned with the rôles played by various European and American nations in the educational and scientific development of the most liberal and progressive of the Central American republics—Costa Rica. It is a centenary volume, issued in the year when these republics celebrated the hundredth anniversary of their independence of Spain. It is divided into two parts.

The first part comprises eight chapters, 61 pages and, in the words of the author, analyzes the different factors which have determined the national culture during the first two thirds of the century of separate existence.

The universities of Spanish colonial America were those of Mexico, Guatemala, León, Santa Fé de Bogota, Lima and Cordoba. They possessed the same medieval culture peculiar to those of the mother country. Essentially conservative, they gave preeminence to ecclesiastical studies and scholastic philosophy, that mistress of theocratic Spain, with her bookish and memorizing systems, narrowness of spirit, filled with preoccupation and routine that offered not the least impulse to scientific investigation.

Their knowledge crystalized in traditional formulae, with essentially mnemotechnical methods of the purest scholasticism, with the order of cyclical teaching and the dogmatism of the peninsular cloisters. Under such conditions the Hispano-American university lived without the stimulus of philosophic and scientific culture which culminated in the teaching institutions of other countries, due to European investigation.

In the early years of the 19th century members of influential families of Costa Rica attended the University of León (Nicaragua), as the nearest institution of higher learning, and through them and other graduates who went to Costa Rica to take part in the political organization of the latter country, after its independence was proclaimed in September, 1921, the Nicaraguan institution exercised great influence on the intellectual and educational development of the neighbor to the south. One of the Leonese alumni was Rafael Francisco Osejo, called in 1814 by the municipality of San José (Costa Rica) to direct the House of Teaching of St. Thomas (*Casa de Ensenanza de Santo Tomas*). Here in 1825, or soon thereafter, modern foreign languages, English and French, were for the first time taught in Costa Rica. Professor Osejo, in his character as a deputy in the Ordinary Assembly, was the author of the first law of public instruction in Costa Rica, promulgated in May, 1832, according to which the municipal bodies were required to oblige fathers of families to procure for their children between the ages of eight and fourteen years instruction in Christian doctrine, reading, writing and numeration, and imposing a fine of 3 pesos per year on those who did not fulfil this obligation.

From about 1840 the influence of the University of San Carlos at Guatemala, with the more liberal tendencies in its organization, began to supplant that of San Ramón de León, especially in law and in medicine.

Immigration from Europe, South America and the other Central American countries followed the establishment of independence and tended to increase the elements of and desire for culture. The first Costa Rican youth to seek an education in Europe, José Maria Montealegre, left his native land in 1826, at the age of eleven, passed through High Gate School in London, obtained the medical degree in Edinburgh and returned home early in 1840. Not until 1863 did Costa Ricans come to the United States to study medicine.

The increasing production of coffee, the establishment of a regular port of call at Puntarenas by steamships of the Pacific Mail in 1856, the arrival and prolonged residence of distinguished German engineers and scientific men like Rohrmoser, Frantzius and Hoffmann, constituted additional factors in the increasing enterprise and development of the country.

In 1848–1850, treaties of amity and commerce were made with Great Britain, France, the Hanseatic cities, Spain and the United States, and accredited representatives of these countries soon began to function in Costa Rica.

The influence of the other Central American states declined with these events in proportion as that of Europe and the United States increased. Nevertheless, the foundation of the Liceo de Costa Rica at San José in 1864 was largely due to Maximo Jerez, a native of León, proscribed by his own country and who, as a result, dwelt in Costa Rica from 1863 to 1868.

A Guatemalan, Felipe Molina, was the first minister plenipotentiary from Costa Rica to the United States, dying in Washington February 1, 1855, while discharging that function. He was the author of the first historical and geographical sketch of Costa Rica, a work which did good service in acquainting foreigners with the possibilities and beauties of the country and which long served as a text-book in the schools and colleges of Costa Rica itself.

A railroad from the Atlantic port of Limon to the capital, San José, was completed in 1891, while that on the Pacific side halted between Orotina and Esparta for some time and was finally extended to Puntarenas in 1910.

All of the movements of which the events mentioned above were the visible signs are duly considered with reference to the intellectual development of Costa Rica.

Beginning in 1869 the Costa Rican government entered into contracts with teachers in various European countries to instruct the youth of the republic. The first of these instructors was Professor Valeriano Fernandez Ferraz, who had occupied chairs in Greek and in Arabic in the universities of Seville and Madrid, and who on reaching Costa Rica organized, and for three years directed, the College of San Luis Gonzaga at Cartago. He was followed to Costa Rica by his two brothers, one of whom, Juan Fernandez Ferraz, became Director of the Museo Nacional in 1898 and served the state in many other capacities.

Others who went to Costa Rica under similar arrangements were the botanist Helmut Polakowsky (1875), and a notable group of young Swiss scientific men, Paul Biolley (1886), Henri Pittier (1887), Gustave Michaud and Jean Rudin (1889), all of whom remained for many years in the country and added greatly to the development of science by teaching and by research.

The second and larger part of the book traces the influence derived from each country to which Costa

Rica has been indebted for her educational and scientific life. One or more chapters are devoted to Germany, Argentina, Belgium, Colombia, Cuba, Chile, Spain, the United States, France, England, Italy, Mexico and Switzerland. The individuals of these countries who have visited and studied in Costa Rica, or who have described her natural productions, are discussed biographically and lists of their publications relating to the country are given. Pedagogical theories and methods proceeding from these different sources are considered with respect to Costa Rican schools and teaching. Four chapters (nearly 100 pages) are devoted to the United States, wherein 103 authors and travelers are named or discussed. The data on books and publications given in this volume constitute a fairly complete bibliography of foreign authors on Costa Rican pedagogy and natural science.

Senor Gonzalez's history is surely of great value to Americanists, Pan-Americans, naturalists and historians of science.

PHILIP P. CALVERT

UNIVERSITY OF PENNSYLVANIA,
PHILADELPHIA

SPECIAL ARTICLES

NOTES BY N. M. STEVENS ON CHROMOSOMES OF THE DOMESTIC CHICKEN

RECENTLY, in looking over a file of old research notes I came across a package of rough notes and drawings by Miss Stevens on the chromosomes of the domestic chicken, which had been given to me after her death. She had been working at this problem at odd times at the same time that Dr. Pearl and I had in 1914. We had sent her adult testis material from the Maine Agricultural Station, and she had also worked on embryos. The present interest in these notes lies in their bearing on T. S. Painter's paper on Reptilian Spermatogenesis (*Jour. Exp. Zool.*, 34, 281–327). Painter says that one object of his study was "to determine what light a study of reptilian spermatogenesis would throw on the spermatogenesis of birds since reptiles and birds are closely related phylogenetically." No one as yet has published any satisfactory results on bird chromosomes. The outstanding feature in the lizard spermatogenesis seems to be the arrangement of the chromosomes in the equatorial plate, a definite number of large chromosomes in a ring around a center group of small chromosomes, the number of which is sometimes difficult to determine. Miss Stevens's drawings show equatorial plates which exhibit a striking resemblance to those drawn from the lizard by Painter. She suggests that there may be a nebula of small chromosomes at the center of the group which clump readily in poor fixation and therefore have often been taken for several large chromosomes.

Her drawings show 12 large chromosomes forming the outer circle in the spermatogonia and usually 6 (occasionally 5 or 7) in the spermatocyte. The num-

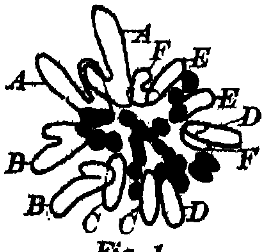


Fig. 1

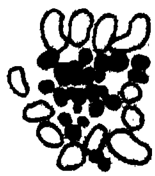


Fig. 2

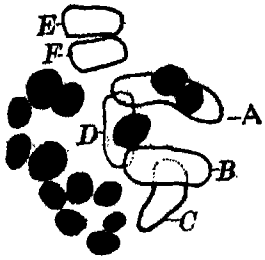


Fig. 3

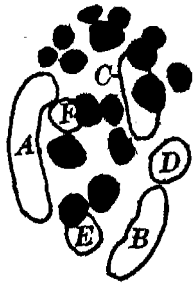


Fig. 4

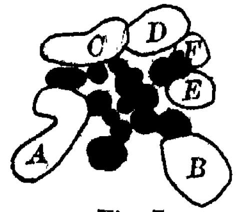


Fig. 5

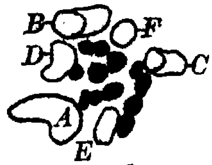


Fig. 6

ber of small chromosomes figured in the center varies, being usually 12 or 14 in the spermatocyte where they are of course easier to identify than in the spermatogonium. I include copies of six of her drawings. They were camera lucida drawings, but had not been finished as these were only fragmentary notes at the beginning of a study. Figures 1 and 2 are spermatogonia, each with 6 pairs of large chromosomes and a mass of small chromosomes. Figure 1 was marked "question as to how many small ones—too thick together." Figure 2 was marked "all rather mixed in the center." Figures 3 and 4 are prophases of the first spermatocyte division. Each shows 6 large chromosomes. Figure 3 has 14 small chromosomes, while Figure 4 has 16. Figures 5 and 6 are equatorial plates of the first spermatocyte division. Here we find 6 large chromosomes; in Figure 5, 14 small, while in Figure 6 there seem to be only 12 small. Some other drawings bear the following comments

which show her uncertainty as to the number of small chromosomes: "Apparently 18, but number of small ones always uncertain"; "large ones all clear, small ones may be more"; "impossible to tell how many small ones."

It may be of interest that part of the notes dated September include some sketches with only 9 chromosomes, and therefore assumed that those with 18 or 20 chromosomes were spermatogonia; while sketches dated November figure the spermatocytes with 18 or 20 chromosomes. One note for November reads "looks as though these were first spermatocytes with about 18 chromosomes." Then come drawings of spermatogonia with many more than 20, such as those copied here.

It has seemed worth commenting on these notes and drawings for the scientific public, now that Painter's careful study of chromosomes in a group phylogenetically close to birds has clearly shown a similar grouping on the equatorial plate, and therefore adds significance and plausibility to Miss Stevens's observations on material evidently more difficult to handle. If she had lived, the processes of bird spermatogenesis would probably have been satisfactorily cleared up before this. But it is hoped that publishing these notes may stimulate some one to continue work on this material and try to settle the matter.

ALICE M. BORING

WELLESLEY COLLEGE

THE PRODUCTION OF EPINEPHRIN BY THE ADRENAL CORTEX

CRAMER[1] concluded from the histological study of adrenals fixed with osmic acid that the cortex participates in the functional activity of the medulla. He found fine black granules similar to the epinephrin granules of the medulla.

We have obtained further evidence that epinephrin is produced by the cortex. The adrenal of a cat recently killed was carefully removed and then frozen with CO_2. Some of the outer portion of the cortex was sliced away with a razor. This material gave a positive test for epinephrin by the Folin, Cannon and Denis[2] reaction. It likewise caused inhibition of a piece of kitten's intestine contracting in Ringer's solution.

The cortex of an adrenal, the medulla of which had been completely destroyed by cautery thirty days previously, gave a positive test for epinephrin by the Folin, Cannon and Denis method. The destruction of the interior of the gland was so thorough that only a thin shell of live cortex remained. Cortex of another adrenal prepared in a similar fashion gave a good inhibition of contracting intestine. By the use of the exercise test[3] we have also obtained an indication of epinephrin production by the cortex. One iris had been made sensitive to epinephrin by the removal of the superior cervical ganglion on that side. One adrenal had been removed and the medulla of the other had been thoroughly destroyed by cautery. After complete recovery, exercise in the treadmill caused dilatation of the sensitive pupil.

Whenever there seemed to be a possibility of the presence of good medulla we have studied microscopically sections of the gland fixed with formaldehyde and potassium bichromate.

Finally, we have used the completely denervated pupil[4] in order to determine whether the cortex produces epinephrin. The excitement caused by shutting off the air from the lungs for 40 seconds rarely fails to produce an increased secretion from the adrenals. Moreover, it produces perhaps the most marked effect among stimuli which are harmless. Our method has been to destroy the medulla of one adrenal by electric cautery several days before the experiment. The reaction to shutting off the air from the lungs was observed, the denervated pupil being measured by a smaller caliper square. The good adrenal was then removed. After recovery from the anesthetic the pupil response to shutting off air from the lungs was again determined. The cauterized adrenal was next removed, a final test of the denervated pupil being made after recovery from anesthesia. The cauterized adrenal was fixed and examined microscopically for the presence of medulla, the whole gland being sectioned (sections of 25μ). Approximately every fifth and sixth sections were saved, the others being discarded.

To be more certain of medullary destruction much of the cortex was destroyed.

Experiments on fourteen cats were completed. A small portion of the medulla remained in five; medullary tissue was absent in nine; but four of these had the cortex almost completely destroyed. The five cats possessing healthy cortex and no medulla in the cauterized adrenal gave good denervated pupil reactions to shutting off the air after removal of the uncauterized adrenal. After removal of the cauterized adrenal the denervated pupil gave a much smaller reaction or no response at all to a similar test.

All of our evidence indicates that the adrenal cortex produces epinephrin.

FRANK A. HARTMAN

THE UNIVERSITY OF BUFFALO

[1] Cramer, W., *J. Physiol.*, 1918, LII, viii–x, xiii–xv.

[2] Folin, O., Cannon, W. B. and Denis, W., *J. Biol. Chem.*, 1913, XIII, 477.

[3] Hartman, Waite and Powell, *Am. J. Physiol.*, 1922, LXII, 225.

[4] Hartman, McCordock and Loder, *Am. J. Physiol.*, 1923, LXIV, 1.

SCIENCE NEWS

THE DENSEST STAR

Science Service

THE densest star in the known universe has been discovered by Professor F. C. Jordan, of the Allegheny Observatory. It is as solid as the surface rocks of the earth and as compact as the planet, Mars, or the moon. Yet it shines so brightly that Professor Jordan was able to determine that it is what astronomers call an eclipsing variable, made up of two elliptical or egg-shaped dwarf stars which whirl round and round, one of them blotting out the light of the other at regular intervals.

The newly discovered variable star, as yet designated simply as "New Variable," is not visible to the naked eye since its magnitude is about eleven, but it is in the constellation of Coma Berenices, which is located a little south of the Big Dipper.

How a star can shine so brightly and yet have a density of the most enduring earthly granite is a mystery to astronomers. "New Variable" is from 3.1 to 4.8 times as solid as water and from 2.2 to 3.4 times as dense as our sun, which is a very compactly built star itself. The average density of all the stars is only one tenth that of water. If an ordinary star were cool enough, a person might enter one, if transported there à la Jules Verne, and not realize it.

But Professor Jordan's star is nearly as solid as the earth which, taken as a whole, is 5.5 times as dense as water. It may be more compact than the moon, which is 3.3 times water's density or Mars, which rates 3.6. It exceeds in solidity Jupiter with density of 1.6 and red Saturn which is only six tenths as compact as water.

The life of the densest star of the known universe is nearly over, astronomically speaking. It is a dwarf that is nearing extinction. Stars that are in the class of eclipsing variables are as a rule more dense than either the red giants such as Antares and Betelgeuse. The variable stars average in density one eighth that of the sun, the great red giants are about one thousandth the density of air at the surface of the earth. Most of the stars are mere vapor, even our very dense sun is only 1.4 times as solid as water, and it is understandable that their material could give off light that can be seen from the earth. But the luminescence of such a solid body as "New Variable" is puzzling to account for, astronomers declare.

The distance of the densest star from the earth has not yet been determined. The density of "New Variable" was determined by computation based on the data for its period and the total duration of its eclipse. The previously known star closest in character to the new star is W Ursae Majoris in the same part of the heavens, which is 2.5 times as dense as water.

"New Variable" is also the star with the shortest period yet known, amounting to about six hours. W Ursae Majoris ranks third in short periods while SW Lacertae is second.

BORNEO ARROW POISON AS AN INSECTICIDE

Science Service

TUBA ROOT, which was used by the "Wild Men of Borneo" as an arrow poison, and is still used in the Malay States as a fish poison, is a most effective insecticide, according to experiments made at the Rothamsted Experimental Station. Experts hope that its more extended use may relieve the shortage of nicotine, which is perhaps the most perfect insecticide known. Tuba root falls short of the ideal in that it is extremely poisonous to animals, including man; hence great care has to be exercised in its use.

Nicotine is one of a very large number of poisons obtained from plants; and the head of the Ministry of Agriculture's Pathological Laboratory suggests that these may include a number of other substances suitable for use as insecticides. Nicotine is not produced in sufficient quantity to meet the demand for it and it is too expensive to be used in general agriculture except by growers of very high priced produce, such as hops.

Hence an investigation has been carried out by Messrs. Tattersfield and Roach, of the Rothamsted Experimental Station, in collaboration with Messrs. Fryer and Stenton, of the Ministry of Agriculture. Thousands of caterpillars, reared in the Ministry's Pathological Laboratory, have been tested to determine the effect on them of the various products isolated from the plants. Great care had to be exercised in rearing the caterpillars to keep them free from parasites and in good health. This is very important, otherwise it could not be decided whether a particular caterpillar died as a result of the action of the substance tested or whether it would have died from other causes had it not been treated at all.

By far the most hopeful of the plants so far investigated is Tuba Root. It contains comparatively large percentages of a series of closely related poisons which are as toxic to caterpillars as nicotine when equal weights of the two are compared.

Tuba Root seems to have been used for an insecticide first by Chinese market gardeners, who macerated the root with water and sprayed their plants with the resulting milky fluid, thereby following the lead of the natives who painted this same fluid on their arrows to poison them. The arrow poison is now used in proprietary insecticides and the demand for it on the English market is steadily increasing.

EXPLORATION OF THE COLORADO RAPIDS

Science Service

COLONEL C. H. BIRDSEYE, chief topographical engineer of the U. S. Geological Survey, will leave Washington in a few days on one of the most adventurous explorations ever undertaken by the government in peace time—a survey of the deep, narrow gorges of the Marble and Grand

canons of the Colorado river, the most dangerous and treacherous in the world.

He will be in charge of a party of ten mapmakers, geologists and boatmen, who will go down the most dangerous section of the river in specially constructed boats. These will be fitted with air chambers. The men are strapped in a little cockpit in the center of these craft, wearing life preservers at all times and provided with long life ropes. The distance to be explored covers about 300 miles through northern Arizona.

The mapping of the Colorado has been in progress since 1909 but the dangerous part has been left for the last. When the party returns this autumn they will have completed records of the slope and topography of the entire stretch of river—an aggregate of about 1,200 miles on the Colorado and Green rivers and several hundred miles of the principal tributaries.

Four of the specially constructed boats will be used, manned by the most skillful boatmen to be obtained in that section, all experienced in shooting rapids. The rapids in this section of the river form some of the wildest water in the United States and each member of the party has been selected for his fearlessness in the face of danger as well as for his ability as a scientist.

Part of the work will consist of locating available dam sites in view of the proposed commercialization of the Colorado.

THE PROTECTION OF ENGINE CREWS IN TUNNELS

THE engine crews who drive the modern monster types of locomotive through the longer tunnels of American railways are frequently exposed to the presence of deadly carbon monoxide gas and to withering temperatures ranging up to 136° F., states the Department of the Interior, as the result of an investigation conducted by the Bureau of Mines in railroad tunnels in Utah and Wyoming. Hot exhaust gases are the source of danger from exposure to tunnel atmospheres. Many serious accidents have occurred in these tunnels due to asphyxiation or exhaustion of the locomotive crews, caused by exposure to atmospheres containing carbon monoxide, or to atmospheres of a high temperature and saturated with moisture. These hazards are accentuated by a group of less importance consisting of sulphur dioxide, hydrogen sulphide, soot and steam, accompanied by the decreased oxygen content of the air.

The Interior Department recommends the use of smoke deflectors on locomotives operating in tunnel districts as a means of reducing the hazard due to high temperatures, and the use of the train air-brake line as a source of air for breathing purposes for members of engine crews.

The object of the Interior Department's investigation, conducted by the Bureau of Mines in cooperation with the Union Pacific Railroad, was to determine the cause of gassing accidents by examining into composition of the air in locomotive cabs while passing through railroad tunnels; to learn the effect of these conditions on the engine crew; and to provide a means of protection for the men so exposed.

Gas samples and temperature readings taken in the cabs of locomotives were used in studying the atmospheric conditions to which the locomotive crews were exposed. The symptoms and the physiological effects produced in men exposed to the atmospheres encountered were studied. The pulse rates and body temperatures were taken, and determinations of the carbon monoxide content of the blood were made. Various methods for the prevention of gassing and for the protection of men therefrom were considered and tested, among which were the use of mechanical devices for deflecting the smoke away from the engine cab, and the use of various types of gas masks and breathing apparatus.

Of forty trips conducted in cabs of locomotives while the trains were passing through tunnels, carbon monoxide was found to be present on thirty-four trips. The operation of twenty-four trains of approximately 2,000 tons each, in a normal running time of six minutes through the Aspen tunnel in Wyoming, showed cab temperatures of 114° F. (dry bulb), 111° (wet bulb), and a relative humidity of 90 per cent. The maximum dry-bulb temperature recorded on any of the forty tests conducted was 136°, while the maximum wet-bulb temperature was 124°. The time consumed in the passage of the trains varied from 4½ to 25 minutes.

Results of physiological tests over periods of 10 minutes showed that the conditions in the cabs might be severe enough to cause asphyxiation or exhaustion in periods of 20 minutes, especially in cases where the engine is stalled.

ITEMS

Science Service

A NEW process in metallurgy said to hold promise of improved methods in the treatment of oxidized and semi-oxidized or "carbonate" ores of copper, lead and silver has been developed through the joint work of the Bureau of Mines and the University of Utah. It is known as the "chloride volatilization process of ore treatment." It depends upon the volatilization of compounds of the metals with chlorine, effected by adding salt or calcium chloride to the prepared ore. The exact chemical reactions are not known and the work is still in the experimental stage although promising great savings in the cases indicated where technical difficulties have heretofore caused much loss.

CHILDREN may suffer from the dietary sins of their parents, Professor A. H. Byfield, of the University of Iowa School of Medicine, told members of the American Medical Association at San Francisco. He described a series of animal experiments in which it was possible to produce rickets, which is due to faulty nutrition, only in the second generation of the animals experimented on. Studies of social conditions lead to the belief that causes extending over more than one generation are necessary for the production of this disease, and indicate a definite method of prevention, he said.

THE windmills that once dotted the Belgian landscape and furnished motive power for innumerable operations on Flanders farms are slowly being replaced by more efficient power machinery.

SCIENCE

Vol. LVIII — August 3, 1923 — No. 1492

CONTENTS

SCIENCE: A Weekly Journal devoted to the Advancement of Science, edited by J. McKeen Cattell and published every Friday by

THE SCIENCE PRESS

Lancaster, Pa. Garrison, N. Y.

New York City: Grand Central Terminal.

Annual Subscription, $6.00. Single Copies, 15 Cts.

SCIENCE is the official organ of the American Association for the Advancement of Science. Information regarding membership in the association may be secured from the office of the permanent secretary, in the Smithsonian Institution Building, Washington, D. C.

Application made for transfer of entry as second-class matter to the Post Office at Lancaster, Pa.

ADVENTURE, ROMANCE AND SCIENCE[1]

Man has struggled up a long trail from the past, leaving many competitors extinct along the way, and stands on the high peak of civilization that we enjoy to-day. Even in the old stone age there was plenty of adventure, with perhaps a little romance now and then—yes, and science, too. From the glimpses that ancient documents give into what went on in times long before they were written, and from conditions that obtain among primitive peoples to-day, it seems probable that there have always been scientists among men. These scientists were, and are, peculiar personalities that wanted to know about things. Even to-day they are often looked upon by many of their companions as men of "authority" and at times treated with respect.

In his life cycle every man roughly recapitulates the past, and (alas!) probably the future, history of the human race. This recapitulation is apparent in many ways, but, as civilized man is judged chiefly by his mind, the present discussion will be confined to mental qualities. A child sucks, feels and views his little world with wonder and admiration; thrills with new sensations—gaining in experience day by day. After a time he finds that he knows something, and becomes a delighted critic of his father's table manners and his little sister's English. Approaching maturity, he wants to do something—just what is uncertain—but something must be done. Man has an instinctive urge for a place in the world. Then the golden age comes—the man finds out what the greatest thing in the world is and begins his life work. He trains and works and looks for responsibility and plans, and—if Fortune smiles—may meet with success. After a life spent in labor, the man finds that he is not as important as he thought in the beginning. Then he takes a little time off now and then to enjoy himself, and sometimes develops a certain degree of toleration for others who are trying to live a life. Finally, man spends his old age feeling more or less apologetic for living at all. But hope never seems to die in the human breast and the old man, though left behind by the next generation and in his soul convinced of his perfect uselessness, does not despair. In fact, he gets considerable satisfaction by telling the rising generation about what he claims is a grand life

[1] Presidential address before the Wisconsin Chapter of Sigma Xi, May 2, 1923.

that he has lived, but what is really such a life as he hopes some of his patient advisees will try to live. Thus the cycle goes round.

The army intelligence tests made it apparent to all the world that there are many eccentrics in the cycle of life. Some personalities are arrested in youth. Every one has known persons who went through their lives thrillfully suckling, handling or viewing each experience—and then waiting for something else. These poor souls of course never attain a place in the world. Others miss their place because they do not earn it, but have a pseudo-place given them by Fortune, and they therefore skip from youth to the enjoyment of the pleasures that normally come after the struggles associated with maturity. Some limited personalities are obliged to begin what should be their maturity with the apologies of old age.

It is indeed fitting that after all these ages and chances for failure we should be felicitated on being here to-night—mature, more or less sane personalities; most of us just beginning careers as scientists. We have every reason to feel proud of the human race for its successful domination of the earth and we may rejoice that we of all the people are the personalities endowed with the appropriate qualities to take up work in the greatest field for human endeavor—science.

I might speak to you in an inspiring way concerning our duty to cooperate or discuss the value of science or the grandeur of research. I have talked the matter over with my wife and she assures me that I am enough of a hypocrite to do any of these things well. Better still, and easier, I might by appropriate arguments show what is wrong with science or religion and point out how we might all live better and more scientific lives. However, I am not going to do any of these things, but only make a few more or less irrelevant remarks concerning science and scientists.

President E. A. Birge in a recent address maintained that there are two types of scientists: (1) those who want to know about the world, and (2) those who want to make the world serve them, Darwin and Pasteur being cited as examples of their respective classes. In my opinion there are at least two other classes of persons that call themselves scientists: (3) politicians, and (4) those who are having a good time. All these classes, with the possible exception of the last, furnish their quota of men who are an honor to science. The inquisitive individuals with unquenchable thirsts for knowledge make most of the discoveries; the practical minds make nature an increasingly valuable servant of man; the politicians hold the offices in scientific societies, appoint the fellows and exercise other power-satisfying functions; the joy-riders of science have a good time. My remarks to-night will be primarily to and for the last class. What opportunities does science offer for enjoying life?

In his delightful work on "The Pleasures of Life" Lubbock says,

"the world would be better and brighter if our teachers would dwell on the Duty of Happiness as well as on the Happiness of Duty; for we ought to be as cheerful as we can, if only because to be happy ourselves, is a most effective contribution to the happiness of others."

The words of such an authority leave no doubt that happiness is both altruistic and scientific. But there are of course various kinds of pleasures, and scientists are undoubtedly worthy of the best. Of all the thrills that man may feel, there are none that have the glamor of adventure and romance.

There are many who feel that Don Quixote, Captain Kidd, Pizarro and other well-known adventurers had all the adventures worth having and that in this modern, do-it-with-electricity and say-it-with-flowers world there are no adventures left that are worth having. There is also a feeling that romance ended with the passing of crusades or that romance is associated with the shinning of fair maids down knotted bed sheets into the arms of poor but worthy lovers, and that Douglas Fairbanks has it syndicated. To convince such doubtful spirits let me quote from the letter that Ross wrote from India after his long struggle to prove that the mosquito transmitted malaria.[2]

"But now, in order to ensure at least definite negative results, redoubled care was taken; almost every cell was examined, even the integument and the legs were not neglected; the evacuations of the insects found in bottles, and the contents of the intestine were scrupulously searched; at the end of the first examination staining reagents were often run through the preparation and it was searched again with care. The work, which was continued from 8 A. M. to 3 or 4 P. M. with a short interval for breakfast,[3] was most exhausting and so blinding that I could scarcely see afterwards, and the difficulty was increased by the fact that my microscope was almost worn out, the screws being rusted with sweat from my hands and forehead, and my only remaining eyepiece being cracked, while swarms of flies persecuted me at their pleasure as I sat with both hands engaged at the instrument. As the year had been almost rainless (it was the first year of plague and famine) the heat was almost intolerable, and a punkah could not be used for fear of injuring the delicate dissections. Fortunately my invaluable oil-immersion object glass remained good.

"Toward the middle of August I had exhaustively searched numerous grey mosquitos, and a few brindled ones. The results were absolutely negative; the insects

[2] Boyce, R. W. 1910. "Mosquito or Man?" London, xvi + 280.

[3] In the tropics "coffee" is served in the morning and "breakfast" about noon.

contained nothing whatever. . . . On August 20 I had two remaining insects, both living. Both had been fed on the 16th instant. I had much work to do with other mosquitos, and was not able to attend to these until late in the afternoon, when my sight had become very fatigued. The seventh dappled-winged mosquito was then successfully dissected. Every cell was searched and to my intense disappointment nothing whatever was found, until I came to the insect's stomach. Here, however, just as I was about to abandon the examination, I saw a very delicate circular cell, apparently lying amongst the ordinary cells of the organ, and scarcely distinguishable from them. Almost instinctively I felt that here was something new. On looking further, another and another and another similar object presented itself. I now focused the lens carefully on one of these, and found that it contained a few minute granules of some black substance, exactly like the pigment of the parasite of malaria. I counted altogether twelve of these cells in the insect, but was so tired with work, and had been so often disappointed before, that I did not at the moment recognize the value of the observation. After mounting the specimen I went home and slept *for nearly an hour*. On waking, my first thought was that the problem was solved, and so it was.

"The mind long engaged with a single problem often acquires a kind of prophetic insight, apparently stronger than reason, which tells the truth, though the actual arguments may look feeble enough when put upon paper. Such an insight is mainly based, I suppose, on a concentration of small probabilities, each of which may have little weight in itself; but in this case, at all events, the insight was there, and spoke the truth."

Oh, boy! Is this adventure? Is this romance?

My friend, Professor H. C. Cowles, recently had an enjoyable experience. Years ago, Cowles had a lot of fun determining what relation the growth rings in tree trunks and the general shape of trees had to wet and dry ground and to rain and drought. Recently the United States sued some lumbermen in Arkansas for cutting timber that did not belong to them. In court the culprits claimed that they had acquired rights by the purchase of claims from early settlers, who had lived on the shore of a lake that dried up about 1840. The whole case hinged on whether there had been a lake or not. Well, Cowles went down there and proved scientifically and conclusively, using cypress trees and stumps as evidence, that there had not been any lake present for at least 150 years. The government got its money all right and incidentally (just to make the joke complete) Cowles got his. If there is any man on earth who has a good time, it is Cowles.

The young man in science says: What are my opportunities? What can science do for me? It is my privilege to point out to him that scientists are a picked, unusual, privileged lot of people, who are much superior and enjoy superior opportunities to those in any other walk in life.

For example, the broker comes home at night and says:

"Friend wife, the lambs have been swarming this week and I brought home a couple of pearl necklaces. If you do not want them just take them back to Spiffany's and exchange them for something else."

"Thank you so much," says the wife.

The scientist returns to his joyful home and says:

"My dear, I have received notice that the Finnish Society for the Discovery of Paleolithic Artefacts has elected me to honorary membership."

"Is that not fine? I am so proud!" says the wife. "I have had a pleasant day, too. I am making over my wedding gown and it is going to look real nice. By the way, John's shoes are all worn out."[4]

A prominent scientist has recently published a spirited resentment and disgustatory against American men of science.[5] This man can not sleep because scientists do not demand and get the money that they really earn. He claims that scientists really contribute all the big ideas to commerce and get little or nothing in return. In fact scientists are often actually obliged to beg for a little money in order to enjoy *themselves doing research*. This writer has, I feel, missed the point of science. The basis for all *social* procedure is *custom*, and while a man goes into science to make discoveries, help his fellows, manage other scientists or even to have a good time, he *never* goes into science to make money. It is not done; that's all. If a scientist tried to do such a thing, he would of course be "impure." To be sure, a scientist can not be blamed if he incidentally does earn a little money through no fault of his own, but to start out *maliciously to do it* is scandalous. As a reward for going without money, scientists enjoy peculiar social privileges that are more or less associated with the fact that they are not concerned primarily with making a modest or a magnificent living, but with the increase of knowledge. The opportunity to think free thoughts, to know and discover are worth more than money to a scientist.

Now, I feel that I ought to admonish the young scientists that they, being of the elect of the earth, should be dignified and moderate in all things. They should in any and all joyful pursuits of course have a good time, but also remember that there are perso in the world who wish to be treated with respect many who wish to sleep. A young Californ ICAL the feelings of a lot of thoroughly scienti cists by crassly improving a considerable plants in order to help out some common cientific lab- sicians? This

[4] There is more of this dialogue, bu has no direct bearing on science, I d that no one ever feeling that enough has been renderaise needlessly a mosphere" which is more or less Bill No. 348 in the

[5] *Sci. Mo.*, 14: 567–577. ession provided

friends of his. A scientist in New York has not only grossly offended a number of his colleagues by refusing to accept certain good old traditions, but during one of his joyrides actually threw mud at the image of God. Such unnecessary occurrences are of course regretted by all, and should be avoided because they are likely to give science a bad name.

Witmer[6] says: "Intelligence is the ability to solve new problems . . . Education is the device of civilization to keep from encountering new problems." A scientist lives largely on ideas. The late John O. Reed once said of one of his colleagues: "I do not particularly mind him, because I know that he really does not think. He only thinks that he thinks." Any one who reads scientific journals soon learns that a certain proportion of the scientific world belongs in the same class with Dean Reed's friend. But, after all, one of the fine things about the scientific attitude of mind is that those who have it think what they please, without fear or prejudice or self-interest. Facts are facts. They require no apologies. Scientific spirit is bound at times to lead those who possess it into conflict with authority and established institutions. But it can not be suppressed. Science is always right because it seeks only for truth, and truth hurts no one. Unfortunately, scientists are not always right.

A scientist has his circulating medium in problems. He deals in and develops problems as a broker deals in stocks and bonds. When his problems are completed he "sells" them to the scientific world by publication, usually at his own expense. For a scientist there is no joy like that of working in his chosen field. Holmes said: "What have we to do with time but fill it up with labor?" To work, to know, to discover and create—for a scientist there is nothing beyond this!

A "real" or "pure" scientist can have little pleasure from life if he begins his career by craftily seeking out the best "field" or "opportunity." Modern genetics tells us that we are preordained to be osteocephs or geniuses. If one works and worries day and night for forty years on what he loves most, he may amount to something, and he may not. Genetics alone knows and it won't tell. At least we can enjoy ourselves. The greatest thing any man can do for science respect himself, love his work—and keep work- wish you scientists a long and happy life—ad- and romantic.

A. S. Pearse

of Wisconsin

tw
tists:
good ti.
ception c
are an hon
with unquen
of the discover 7.
an increasingly
cians hold the of
the fellows and ex
tions; the joy-riders

THE MAINTENANCE OF ORGANIC MATTER IN SOILS

None of the hypotheses for the origin of the earth make any provision for the presence of combined nitrogen in the lithosphere. All productive soils, however, contain this element in some form generally closely related to the organic matter present, and nitrogen is one of the plant food elements essential to the development of all higher forms of plant life. The atmosphere must, therefore, be the primary source of all soil nitrogen, and its incorporation in the soil is dependent upon precipitation, free fixation and the fixation power of legumes. Such incorporation has had an opportunity to continue for long geological periods with the result that there has been a gradual accumulation. Under conditions where there have been no losses through leaching, this accumulation is not only directly proportional to the precipitation received, but naturally also to the amount of vegetative growth produced on the soil. The tendency has been in nature to convert this nitrogen into an organic form and it is in this form that practically all of the soil nitrogen exists. Results from various soil investigators working in widely different climatic sections have shown that the ratio between the nitrogen and the organic matter and also between the carbon and the organic matter is practically a constant. This constancy is so well established by experimental data that the approved methods for determining soil organic matter are based on the carbon and nitrogen content of the soil.

$$\text{Organic matter} = \text{Carbon} \times 1.724$$
$$\text{or Organic matter} = \text{Carbon dioxide} \times .471$$
$$\text{or Organic matter} = \text{Nitrogen} \times 20$$
$$\text{then } \frac{\text{carbon}}{\text{nitrogen}} = \frac{20}{1.724}$$
$$\text{or Nitrogen : Carbon :: 1 : 11.6}$$

This ratio of practically 1:12 is established by nature at a point where it has a very pronounced relationship to productivity. It is found that where organic matter composed largely of low nitrogen-carrying material is applied to a soil, nitrate accumulation is inhibited to the extent that crop development is retarded. This effect on nitrate accumulation is felt until sufficient carbon has been eliminated as carbon dioxide in the process of decomposition to establish a nitrogen-carbon ratio of about 1:12 in the remaining material.

Under natural conditions where no special effort is made to encourage nitrification and where all vegetative growth reverts to the soil, plant development

will take place about as rapidly as nitrogen becomes available, so that all possibilities of nitrogen losses through leaching are largely eliminated and a gradual increase in the organic matter proportional to the increase in nitrogen must and does follow and the 1:12 nitrogen-carbon ratio is maintained. It is only under conditions of intensive tillage where excessive amounts of nitrogen are removed regularly by cropping or leaching that there can be any very pronounced loss of organic matter. In this process of organic decomposition the carbon is lost more rapidly than nitrogen with the result that the nitrogen-carbon ratio is always slightly narrower in cropped than in virgin soil. The close relationship between nitrogen and carbon makes it impossible to increase or maintain organic matter in the soil unless nitrogen is increased or maintained in like proportion, and, conversely, it is impossible to increase the organic nitrogen without a proportional increase in the total organic matter.

Because of the fact that the benefits of soil organic matter in its relation to available plant food and to physical condition are thoroughly appreciated, attempts have been made to increase this material in the soil, but nearly always with disappointing results. To effect such increase in a measurable degree during the short periods over which records have been kept would require what in reality amounts to a change in climatic conditions. Under irrigated conditions, where the introduction of water on a soil well adapted to legume culture and decidedly deficient in nitrogen meant a heavy production of vegetation and a rapid fixation of nitrogen, it has been possible to increase the organic matter in the soil over and above that in the virgin state. This is practically the only condition under which increases are possible. Under other climatic conditions all attempts at even maintenance have been confronted with many difficulties and disappointments.

In the humid sections liberal annual applications of manure for long periods have had little or no permanent effect, while in the arid regions the return of straw to the soil can not be justified on the basis of improved physical condition of the soil resulting from an increase of soil organic matter. These results are readily explainable when it is realized that manure contains *only about ten pounds of nitrogen per ton*, and when applied at the rate of ten tons per acre will not more than supply the nitrogen removed by leaching and cropping. In the case of straw, which also contains about ten pounds of nitrogen per ton, and which is recommended for application at the rate of about one ton per acre, practically no influence is felt and little should be expected, because, true to the constant nitrogen-carbon ratio, these ten pounds of nitrogen can fix only about 120 pounds of carbon or a total of about 200 pounds of organic matter, a smaller amount than needs to be decomposed to supply the nitrogen required for one crop.

To maintain soil organic matter, emphasis should be placed on the nitrogen, and if this element is maintained sufficient carbon will be fixed. Nitrogen can be maintained, in part at least, through the use of fertilizers and the growth of legume crops. Even where inorganic fertilizers like sodium nitrate or ammonium sulphate are applied in connection with straw or other low nitrogen-carrying residues much of the nitrogen will be fixed with the carbon in an organic form in the process of decomposition. In the case of maintenance with legumes, worn-out soils can be decidedly influenced, as is evidenced by the pronounced improvement in the physical condition following immediately after the legume sod is broken up. When manure or strawy crop residues are applied this effect is not nearly as pronounced. In one case *there is not sufficient carbon to fix all the nitrogen* and large amounts are made available either to be lost by leaching or to cause a lodging or burning effect on the succeeding crop, while in the other case there is too much carbon for the nitrogen and in the process of decomposition much carbon is lost and little nitrogen is made available. This also results in decreased yields.

In sections where climatic conditions make it necessary to follow a legume sod with small grain, a crop that does not require excessive amounts of nitrogen, but nevertheless is decidedly dependent on small amounts of available nitrogen early in the season, difficulty is experienced in maintaining the organic matter supply.

The ill effects of legumes or straw used singly can be overcome by introducing the straw as a surface dressing on the legume sod before it is broken up. Besides this, it is reasonable to assume, consistent with the constancy of the nitrogen-carbon ratio, that much of the nitrogen and carbon that would be lost in the process of decomposition where the materials are used singly is now fixed, thus resulting in the more rapid accumulation of desirable soil organic matter.

F. J. Sievers
Washington Agricultural Experiment Station

MEDICAL LICENSURE OF NON-MEDICAL DOCTORS

What would result if most of our scientific laboratories were placed in charge of physicians? This question may be countered by saying that no one ever entertained such a thought; why raise needlessly a troublesome question? But House Bill No. 348 in the Pennsylvania legislature now in session provided

That no laboratory procedure for the diagnosis or treatment of human disease shall be performed or reported by persons who have not a license to practice Medicine and Surgery . . . , except under the direct supervision and upon the personal responsibility of a physician. . . .

The duty of the State was mapped out before the Section on Pathology and Physiology of the American Medical Association at St. Louis, May, 1922, and House Bill No. 348 was in accord with the view there expressed:

As long as non-medical laboratorians . . . submit reports to physicians only, it may be granted that it makes little difference to the State whom the physician calls on for these examinations or for even the interpretations of the results. . . . But provision should be made for the examination and licensure of the doctors of philosophy and hygiene and other technicians who are not doctors of medicine. . . .

Whatever appeal this naïve statement makes is changed when one reads further from the same hand:

Many physicians—probably the majority—give little or no attention to the qualifications of those to whom their laboratory work is entrusted. . . . As a general rule, practicing physicians do not realize the many chances for error in laboratory work; "to them a test is a test regardless of by whom or how it is made."

The reader will find it an interesting excursion through the two papers presented and the discussion thereby evoked, in the meeting at St. Louis.[1] Doctors of philosophy and hygiene will find, supplied by doctors of medicine, details lacking in the definition of the word *technician*: ". . . a technician (perhaps some girl who has had a year or so training);" "usually some girl who is looking for a job or a relative of the doctors;" ". . . a girl, with or without a high school education."

In Pennsylvania we had to meet a situation. House Bill No. 348 had passed first reading before the chemists learned of its existence. Its wording was found to include every laboratory procedure related in any way to human disease. It provided for the summary closing of a laboratory without hearing or appeal. It created a laboratory monopoly for physicians. By it doctors of philosophy were disqualified from practicing the laboratory procedures they are paid by physicians to teach young physicians how to do. Druggists and owners of pharmaceutical laboratories were compelled, on pain of closure, to take on physicians as partners. The genius of the evils this bill was said to remedy appeared to be *Frankenstein*, with the given name "Technician," who is inflicting retribution upon his creators. All of the evils complained of were already capable of correction by proper enforcement of the Medical Practice Act of the Commonwealth.

If my reader is himself a physician he may better picture the potentialities in such a bill by using an analogy. Let him suppose the State Bar Association has a law passed putting all laboratory procedures relating (ever so remotely, perhaps) to crime under the direct supervision of a lawyer. Let him follow out the analogy and try to select in his own community the lawyer honestly capable of such supervision over a biologist or chemist or physician. Let him see the lawyer-partner in every doctor's office, in every drug store and food factory and every other business or profession in which the crime of adulteration or any other malpractice may enter. The possibilities of this analogy are great, and its pursuit illuminating.

The many factors in law and medicine and religion that rest upon tradition or prejudice are, in time, doomed. The development of the essentials to civilization can not but be attended with great travail. But the methods of the middle ages are behind the times; and abuse of power (even with good intentions) is insufficient to solve difficulties incident to intellectual evolution.

The spectacle of House Bill No. 348 makes it wise for doctors of philosophy and hygiene and many others to watch their legislatures. Something may happen in any of the states any time. It would be inexplicable if a considerable number of physicians should support House Bill No. 348 or other bill equivalent to it. To do so would be to invite a fight that can end in but one way. A contest with highly trained men whose lives are spent in exact experiment and careful reasoning is not to be undertaken lightly. Considerations of policy, alone, would suggest caution. When enough has been done to lead doctors of philosophy and hygiene in this country to tell laymen convincingly the indisputable truth about the doubts and shortcomings and failures of medicine, to lead druggists to add to this what they know by experience of the physician in the prescribing and compounding and dispensing of medicines, to lead pharmaceutical manufacturers to add to this the facts of experience gained in making their advertising and sales campaigns among physicians successful—what will be the outcome financially for the average practicing physician?

House Bill No. 348 was *killed in committee* and escaped the publicity due it had it come before the House and Senate for discussion. But parties at interest over the whole country should know about it. "Forewarned is forearmed."

DAVID WILBUR HORN, PH.D.,
Chairman, Committee on Legislation,
Phila. Section, American Chemical Society

[1] *Journ. Amer. Med. Assoc.*, 1922, p. 861 ff.

SCIENTIFIC EVENTS

THE ANNUAL REPORT OF THE BRITISH MUSEUM

THE annual report of the British Museum for 1922 records that the number of visitors to the museum continues to rise. The total for 1922 was 979,297, an increase of 78,000 over the preceding year, and the highest figure recorded in this century. Of these visitors, 918,354 came on week-days and 60,943 on Sundays. The visits of students to particular departments also increased, though in a smaller proportion. The visits to the reading room were 164,775, as against 159,177; those to the newspaper room 10,941, as against 10,034; and those to other departments 31,291, as against 27,391.

The number of separate objects incorporated in the collections in 1922 was 388,566, as compared with 369,335 in 1921, the most striking increase being in the Department of Coins and Medals.

The total number of visitors to the Natural History Museum during 1922 was 498,841, as compared with 479,476 in 1921. The attendance on Sunday afternoons was 74,197, as against 61,511 in the previous year, and the number of persons present at the demonstrations of the official guide during the year was 14,515, an increase of 1,040 on the number—13,475—for 1921. The average daily attendance for all open days was 1,374; for week-days, 1,370; and for Sunday afternoons, 1,400.

At the beginning of November the Northern Geological Galleries were added to those open to the public on Sunday afternoons, thus removing the last remaining difference between Sundays and week-days with regard to the exhibition galleries open to visitors.

THE BUREAU OF PHYSICO-CHEMICAL STANDARDS AT BRUSSELS

THE function of the Bureau of Physico-Chemical Standards, established by the International Union of Pure and Applied Chemistry, is the study of the preparation of standard substances to be used as reference substances for physico-chemical measurements carried out in the various laboratories of the world. Samples of the following standard substances are now available for distribution to the chemists of those countries belonging to the union.

A. Standard substances prepared at Brussels and intended primarily for the calibration of low temperature thermometers. The freezing points of the following substances reproduce to $\pm 0.1°$, the scale of the helium thermometer of the Cryogenic Laboratory of the University of Leyden (Compt. rend., Vol. 174, p. 365, 1922).

Carbon tetrachloride	— 22°, 9
Chlorbenzene	— 45°, 2
Chloroform	— 63°, 5
Ethyl acetate	— 83°, 6
Carbon disulphide	— 111°, 6
Ether (stable form)	— 116°, 3
Ether (metastable form)	— 123°, 3
Methylcyclohexane	— 126°, 3

Fifty cc. samples of each of these substances are available in ampoule at 25 Belgian francs per sample. All orders should be addressed directly to the bureau. Other materials are in course of preparation.

B. Supplementing the preparations of the bureau are the following standard materials prepared by the U. S. Bureau of Standards at Washington and obtainable directly from that Bureau (Bureau of Standards Circular No. 25): Cane-sugar, for calorimetry and saccharimetry; naphthalene, for calorimetry; benzoic acid, for calorimetry; sodium oxalate, for oxidimetry; dextrose, for use as a reducing agent; benzoic acid, for acidimetry; tin, zinc, aluminum, copper and lead, with stated melting point, for use in thermocouple calibration.

All the above standard samples are accompanied by instructions for use.

The Bureau of Physico-Chemical Standards plans to act as a center for the study of pure materials, and it requests that authors of papers in this field send reprints of their papers to the bureau. It also hopes that industrial organizations may be willing to contribute to the bureau materials which may be used as the starting point for the preparation of highly purified substances.

THE MOORE SCHOOL OF ELECTRICAL ENGINEERING AT THE UNIVERSITY OF PENNSYLVANIA

THROUGH a merger with the Moore School of Electrical Engineering, provided for in the will of the late Alfred Fitler Moore, as a memorial to his parents, the University of Pennsylvania is to become the seat of one of the best-equipped and endowed schools of electrical engineering in America. This became known through an announcement by Provost Josiah H. Penniman of an agreement between the Moore trustees and the trustees of the university by which the two are to be merged under the name of the Moore School of Electrical Engineering. The new school is to have the income from a fund of $1,500,000 left by Mr. Moore, as well as the funds hitherto at the disposal of the university's electrical engineering department.

In announcing the establishment of the new school, Provost Penniman said:

> The university has already available in its present engineering building sufficient space for this new school, at least for the present, and also ample modern equipment to take care of the present needs of this school; for the entire equipment of the electrical engineering

department of the university will become the equipment of the Moore School of Electrical Engineering.

The income from the Moore fund will be available to meet the yearly expenditures necessary to provide instruction of the highest grade in electrical engineering. The increased income thus rendered available for training students of electrical engineering will be used not only to improve what we have already found to be good, but also to develop the subjects through original investigation carried on by faculty and students, so that the school will almost at once take a foremost position among schools of electrical engineering.

There will be additions made to the teaching staff to make it possible to give to each student individual and intimate and personal attention, and these additions will be men of ability as inspiring teachers and also investigators of recognized standing.

The new school, which will probably be ready for operation in the fall, will bear somewhat the same relationship to the university as does the Thomas W. Evans Institute, which is the School of Dentistry of the university. Mr. Moore, who was a manufacturer of insulated wire, died on September 18, 1912. Under the terms of his will, his estate was retained in trust during the lifetime of his wife, Emily Louisa Moore, who died this year.

DARWINISM AND MR. BRYAN

A press dispatch to the daily press from Atlanta under the date of July 24 reads:

Organization of Southern Legislatures against the menace, as he sees it, of the teachings of Darwinism or agnosticism in public schools, is apparently the present undertaking of William Jennings Bryan. In the past several months Mr. Bryan has visited virtually every general assembly in the south, and asked the legislators to go on record as opposed to the teaching of such doctrines. So far as known he has met with more than fair success.

A measure cropped up in the Georgia Assembly yesterday which if adopted would give it as the "sense" of that body against the teaching at all of atheism or agnosticism and of Darwinism as truth in any of the State's public institutions. Mr. Bryan spoke in behalf of such measures several days ago.

When the Florida Legislature was in session in April and May, Mr. Bryan appeared with a prepared speech against those who believe they descended from monkeys, the disbelievers and those who profess ignorance. A resolution placing that assembly on record as opposed to anti-religious teachings in the public schools of that state was passed. He also went before the Arkansas Legislature and others.

The stereotyped resolution as written by Mr. Bryan for presentation in the various state assemblies has been modified and seldom encounters any opposition now. The insertion of the words "as truth" in the reference to the teachings of Darwinism has served to embarrass opposition.

AWARD OF THE DANIEL GIRAUD ELLIOT MEDAL

The committee of the Daniel Giraud Elliot Medal desires to receive nominations for the awards of the years 1921 and 1922, which are still open, because the committee has not been able to reach unanimous conclusion on any work thus far brought to its attention. The Elliot Medal is awarded for some especially great contribution, not for general accomplishment, in the field of either zoology or paleontology. It is not restricted in either branch to the vertebrates, but may be made in either the vertebrate or invertebrate field and is open to scientists of the world. Some idea of the character of the award may be gained from a review of the previous awards, which were made in 1917 to Frank M. Chapman for his "Distribution of Bird Life in Colombia," in 1918 to William Beebe for his "Monograph of the Pheasants," in 1919 to Robert Ridgway for his "Birds of North and Middle America" (Part VIII), and in 1920 to Othenio Abel for his "Methoden der Palaobiologischen Forschung." The award of the beautiful gold medal is accompanied by a generous honorarium. The committee desires to receive further nominations for the two years mentioned, namely, 1921 and 1922, and also for 1923. Communications should be addressed to the Secretary of the National Academy of Sciences, Washington, D. C.

SCIENTIFIC NOTES AND NEWS

At the last meeting of the Botanical Society of America, provisions were put into effect for the election of corresponding members from among distinguished contributors to the science of botany. The first members elected were Professor Hugo de Vries, of Holland, and Professor F. O. Bower, of Glasgow.

Dr. D. T. MacDougal, of the Carnegie Institution of Washington, has been elected an honorary fellow of the Botanical Society of Edinburgh.

Dr. Ralph L. Thompson, St. Louis, has resigned as professor of pathology at St. Louis University School of Medicine, following twenty years of service. The university has decided to name the museum the Ralph L. Thompson Collection of Pathological Specimens.

Eugene H. Pool, M.D., of New York, has been awarded a distinguished service medal with the following citation: "As surgical consultant with the 4th Corps, 5th Corps, and then the 1st Army, he displayed unusual organizing ability, excellent judgment, and professional attainments of the highest order in directing the work of surgical teams in the care of large numbers of wounded in various hos-

pitals at the front during the St. Mihiel and Meuse-Argonne offensives, thereby rendering services of great value to the American Expeditionary Forces."

THE University of Maryland has conferred the degree of doctor of science upon Lore A. Rogers, bacteriologist in charge of the Dairy Research Laboratories of the U. S. Department of Agriculture, in recognition of his researches in bacteriology and dairy technology.

THE honorary degree of doctor of science was conferred at commencement by Smith College on Dr. Florence Gilman, chairman of the department of hygiene and physical education at the college.

THE degree of doctor of laws has been conferred by the University of Birmingham on Dr. F. W. Aston, of the University of Cambridge, in recognition of his distinguished contributions to chemistry.

AT the Cambridge meeting of the Society of Chemical Industry, Dr. E. F. Armstrong was elected president. The vice-presidents are Dr. T. H. Butler, Mr. F. H. Carr, Professor G. G. Henderson and Mr. E. Mond.

THE last list of British honors contains the names of the following men known for their scientific work: *Baronet:* Sir Anthony A. Bowlby, president of the Royal College of Surgeons. *Knights:* Dr. G. F. Blacker, dean of University College Hospital Medical school, and Professor W. M. Flinders Petrie, Edwards professor of Egyptology, University College, London.

THE prize founded by the king of Italy at the Accademia dei Lincei, Rome, was divided this year between Professors G. Levi and U. Pierantoni, of the University of Turin, for work on "Normal and pathologic morphology."

THE National Alliance for the Increase of the French Population has awarded the first prize of 50,000 francs to M. Paul Haury for the best popularly written pamphlet on the decreasing birth rate and the tragic consequences to the nation. Forty-four other prizes for essays on depopulation, ranging from 1,000 to 8,000 francs, were distributed. Half a million copies of Haury's booklet are to be printed at once.

DR. T. ROYDS has been appointed director of the Kodaikanal and Madras Observatories in succession to Mr. J. Evershed, who retired on February 25.

DR. B. COLEMAN RENICK, graduate of Chicago University and recently on the teaching staff of the University of Iowa, has been appointed assistant geologist in the ground water division of the U. S. Geological Survey and began work in Montana on July 1.

DR. ROSCOE W. THATCHER has been appointed director of the Experiment Station at Cornell University. Under this appointment, Dr. Thatcher will direct the agricultural research at the state station at Geneva, as formerly, and also at the Cornell University station at Ithaca.

DR. E. S. LARSEN, Jr., who, as was recently announced, has been appointed professor of petrography at Harvard University, will relinquish his work as chief of the section of petrography of the U. S. Geological Survey on September 1.

JOHN C. BRIER has resigned as professor of chemical engineering at the University of Michigan to engage in the development of technical service for the Glidden Company.

F. W. SULLIVAN, Jr., has resigned from the teaching staff of the department of chemistry at the University of Michigan to go into research work with the Standard Oil Company (Indiana) at Caspar, Wyo.

PAUL M. GIESY has been made director of the Brooklyn Research Laboratories of E. R. Squibb & Sons.

C. C. CONCANNON, for the past eight months acting chief of the division of chemistry of the Bureau of Foreign and Domestic Commerce, has been appointed chief of the division.

DR. LOUISE STANLEY, a native of Nashville, Tenn., and now dean of home economics at the University of Missouri, Columbia, Mo., has been selected by Secretary Wallace to head the newly established bureau of home economics of the Department of Agriculture. She will begin her work on September 1.

DR. N. L. BOWEN, petrologist, of the Geophysical Laboratory, Carnegie Institution of Washington, is spending the summer studying the igneous rocks of England, Scotland, Norway and Sweden.

MR. W. A. F. BALFOUR BROWNE, of Caius College, Cambridge, sailed on June 14 for Rio de Janeiro with a small expedition, returning in September or October. The object is to observe the land fauna of the tropics under natural conditions, *i.e.*, the structure of the animals and particularly insects, in relation to the functions they perform. The members of the expedition are Mr. L. H. Matthews, of King's (Mammals), Mr. W. S. Bristowe, of Caius (Spiders), Mr. G. L. R. Hancock, of Trinity (Ichneumons), Mr. Cott (Hymenoptera), and Mr. Sanders, a research student in the Molteno Institute (Parasitic Insects).

MR. J. M. WORDIE, geologist of the Shackleton Expedition of 1914, has left Bergen with a party from Cambridge University for East Greenland, where

three months will be spent in scientific investigations. An expedition under Mr. Chaworth Musters, who accompanied Mr. Wordie to Jan Mayen Island in 1921, has left for Franz Joseph's Land.

Sir Thomas Oliver, the distinguished British authority on occupational diseases and member of the anthrax committee of the League of Nations, expects to visit this country during September and early October. Sir Thomas intends to make industrial plant inspections of oil refineries, by-products, coke ovens, steel works, asbestos mills, potteries, of which Sir Thomas has made a special study, white lead works, sugar refineries, limestone mills, packing houses, woolen and cotton mills, rubber factories, paper mills, etc. He is expected to reach Boston by October 6 in time to address the American Public Health Association. His visits will include Harvard, Yale, Johns Hopkins and Tulane Universities. His itinerary is in charge of Dr. Frederick L. Hoffman, consulting statistician of the Prudential Insurance Company.

Dr. S. F. Acree has been in Washington conferring with government chemists working on colloids. Professor Acree states that he now is able to take microphotographs of 3,000 diameters in the fiftieth of a second, which makes possible the securing of motion pictures showing the progress of microscopic reactions.

Professor J. W. McBain, of the University of Bristol, is to give a dedication address in connection with the opening of the Chemical Laboratory at Brown University.

The nineteenth Dutch Congress of Medical and Natural Sciences was held recently at Maestricht under the chairmanship of Professor Spronck, who gave the opening address.

Dr. Edgar F. Smith recently returned from a trip to Louisiana, Texas and Arkansas, where he addressed sections of the American Chemical Society and delivered commencement addresses at Rice Institute, Texas, and at the University of Arkansas. He spoke at Tulane University, and at Rice Institute officiated in the ceremony of breaking ground for a new chemical laboratory, presenting the authorities with an autograph letter of Joseph Priestley, the discoverer of oxygen.

On June 22 there was installed on the campus of the University of Oregon the Oregon Chapter of the Society of the Sigma Xi, with a charter membership of twenty-seven. Professor Henry B. Ward, national president of the society, and Professor Edward Ellery, national secretary, were the installing officers. A noticeable feature of the meeting was the large attendance of visitors from neighboring institutions, Oregon Agricultural College, Reed College, University of California, and University of Washington being represented. The following officers were elected: *President*, Dr. A. E. Caswell; *vice-president*, Dr. G. E. Burget; *secretary*, Dr. H. B. Yocom; *treasurer*, Dr. H. R. Crosland.

On July 11, Professor Edward Kasner, of Columbia University, spoke on "La courbure de Ricci et sa généralization" at the meeting of the Société Mathématique de France in the Sorbonne; and Professor J. F. Ritt spoke on "Les fonctions algébriques qui s'expriment par des radicaux."

It is stated in *Nature* that the centenary of the death of the horologist, Abraham Louis Bréguet, will be celebrated in Paris, October 22–27, by an exhibition of his works at a special meeting at the Sorbonne, and a reception at the Hôtel de Ville. The Congrès National de Chronométrie will also meet in Paris in October, under the honorary presidency of M. Bailland, director of the Paris Observatory, and of General Sebert. Besides discussing general questions relating to chronometry, the congress will aim at the formation of a Chronometric Union under the direction of the International Research Council.

A circular tablet of blue glazed ware bearing the inscription "James Clerk Maxwell (1831–1879), Physicist, lived here," has been affixed to 16 Palace Gardens Terrace, Kensington, where Clerk Maxwell resided for a time, by the London County Council. Maxwell's occupation of the house probably dated from the latter part of 1860, immediately after his appointment to King's College, or the early part of 1861.

Dr. F. C. Cook, for twenty years physiological chemist of the Bureau of Chemistry, U. S. Department of Agriculture, died at Dallas, Texas, on June 19, 1923, in his forty-sixth year. His scientific studies and publications were concerned with metabolism, enzymes, insecticides and fungicides.

Robert Woolston Hunt, the metallurgical engineer and founder of the firm bearing his name, died on July 11, aged eighty-five years. In 1912 he was awarded the John Fritz medal for his contributions to the early development of the Bessemer process.

Mr. S. S. Hough, F.R.S., astronomer at the Cape of Good Hope, died on July 8, aged fifty-three years.

Sir Henry Hoyle Howorth, F.R.S., an authority on politics, science, history and archeology, died on July 8, aged eighty-one years.

Sir Benjamin Simpson, formerly sanitary commissioner and surgeon-general with the government of India, died on June 27, aged ninety-two years.

THE death is also announced of Dr. H. Lacombe, professor of physical and natural sciences at the University of Rio de Janeiro, editor of the *Revista de Medicina*.

THE second International Congress of Comparative Pathology will be held in Rome from October 7 to 14. Information can be obtained from Professor Perronetto, 40, Corso, Valentino, Turin.

THE Sayre Observatory of Lehigh University has been closed, as the observatory is rendered useless for accurate scientific work by the vibration of the earth caused by the passage of street cars a quarter of a mile away.

THE Committee on Guaranteed Reagents and Standard Apparatus of the American Chemical Society will hold an open discussion on chemical reagents at one of the sessions of the Industrial Division at the Milwaukee meeting. The discussion will be a friendly exchange of experiences such as might take place if two or three were talking together at lunch. The details of the meeting will not be published. Names, dates and analyses will be reported showing the good and bad reagents received at various laboratories. Manufacturers will be invited to explain some of their difficulties in finding out the requirements for various reagents and in meeting these requirements. In order that the time may be used to the greatest advantage any one who has definite facts to present should send a copy of his data to the chairman of the Committee on Guaranteed Reagents and Standard Apparatus, W. D. Collins, U. S. Geological Survey, Washington, D. C. It is possible that the amount of material to be presented will not leave much time for general discussion or for the reciting of facts not previously submitted to the committee. Instances of good service and deliveries of exceptionally good reagents will be more valuable to the hearers than instances of the opposite kind.

WM. GAERTNER & CO., manufacturers of scientific instruments, who have been located at 5445–49 Lake Park Avenue, Chicago, for over twenty-five years, have commenced building a factory and office building, which will occupy the southwest corner of Wrightwood and Racine Avenues. The new building, 154 x 135 feet, will cost in the neighborhood of $150,000. It has been designed by the Chicago architects, Schmidt, Garden and Martin, and will be equipped with all modern facilities for the production of scientific instruments, including astronomical telescopes.

A TRACT of forty-four acres of land in Minneapolis on the banks of the Mississippi River, valued at $100,000, and an endowment fund of $900,000 have been given to the University of Minnesota for the construction and endowment of a hospital and convalescent home for crippled children. This gift is from William Henry Eustis, a former mayor of Minneapolis, who a month ago presented 21 acres of land to the city as a site for the Dowling School for Crippled Children, which the board of education of Minneapolis will erect. The children's hospital will be erected on the campus of the medical school, and the riverside tract will be retained as a site for the convalescent home.

IT is planned to hold a reunion of former students and staff members of the Lick and Students Observatories of the University of California on Tuesday, September 18, at Pasadena. All interested are urged to arrange to be present.

UNIVERSITY AND EDUCATIONAL NOTES

THE General Education Board of the Rockefeller Foundation has promised Oberlin College $500,000 on condition that an additional $1,500,000 be raised.

DR. ERNEST DEWITT BURTON, who has been acting president of the University of Chicago since the retirement of President Harry Pratt Judson in February, was elected president of the institution at a meeting of the board of trustees on July 12.

DR. F. L. RANSOME, geologist of the U. S. Geological Survey since 1900, has accepted an appointment as professor of geology and head of the department at the University of Arizona.

DR. ERNEST ANDERSON, for the past three years professor of general chemistry in the University of Nebraska, has been appointed professor of chemistry and chairman of the department of chemistry in the University of Arizona.

DR. GEORGE W. PUCHER has been appointed associate in the department of biological chemistry, University of Buffalo Medical School. He will retain a consulting and research connection with the Buffalo General Hospital.

DR. V. H. YOUNG has resigned the headship of the department of botany and plant pathology at the University of Idaho to become head of the department of plant pathology at the University of Arkansas.

IN the department of anatomy at Cornell University Medical College the following promotions have been made: Robert C. Chambers to professor of microscopic anatomy; Charles V. Morrill to associate professor of anatomy, and George N. Papanicolaou to assistant professor of anatomy. Dr. Louis Hausman is appointed an instructor in anatomy.

DR. J. READ, professor of organic chemistry since

1916 in the University of Sydney, has been appointed to the chair of chemistry in the University of St. Andrews.

DISCUSSION AND CORRESPONDENCE

THE UNIVERSITY OF TENNESSEE AND PROFESSOR SCHAEFFER

The Board of Trustees of the University of Tennessee has dismissed five professors from the university, among them, Dr. A. A. Schaeffer, professor of zoology. The dismissal of Professor Schaeffer seems especially significant inasmuch as he is president of the local chapter of the American Association of University Professors, and this chapter had made request for an investigation of the case of Professor Sprowls, who was dismissed from the university some months ago. No satisfactory reason for the dismissal of Professor Sprowls has been given, it may be mentioned incidentally, but it is believed that a certain opposition to his introduction of the evolutionary point of view into his educational work contributed to the result. Professor Schaeffer was at the Marine Laboratory of the Carnegie Institution of Washington in the Gulf of Mexico when dismissed. Immediately before leaving Knoxville in June the president discussed with him a special appropriation for his laboratory and was far from showing any dissatisfaction with him. The action of the president seems to be a direct challenge to the American Association of University Professors to show whether it has any potency. Meanwhile the loss of Professor Schaeffer to the University of Tennessee is bound to be the gain of some other university.

Chas. B. Davenport

THE STREAMS OF LONG ISLAND

The interesting difference between the east and west banks of the streams of Long Island has been the basis of suggestive comment by contributors to Science. Jennings,[1] who doubts that the westerly deflection of the streams by the earth's rotation is most largely responsible for the steeper west bank and the imperceptibly sloping eastern one, is more inclined to attribute these conditions to the cumulative effects of wind and wind-borne materials, particularly after consideration of the geological history of the region. Hayes[2] states that because of the earth's rotation, longitudinal rivers in the northern hemisphere erode their right banks, whether they flow north or south, while Davis[3] recalls that in the plateau of Launemozen, at the northern base of the Pyrenees, the valley sides facing against the wind are the steeper, while in Long Island they face with the wind. French physiographers explained the former condition not as a consequence of the earth's rotation, but as the result of the stronger action of rain driven by westerly winds. In this case it is of course conceivable that drifting materials would be held in quantity by the denser vegetation of the moister stream margin only when other conditions enabled vegetation to be present in a quantity sufficient to retain it, and to prevent the erosion of that bank. This presumably finds additional explanation in the downward sweep of the winds.

Following Jennings's suggestion, I have studied cross sections of the banks of four small streams of Long Island, two near Oyster Bay, one below Mineola and one emptying near Glen Cove. Comparative cross sections of the steeper west bank and the eastern one indicated that pebbles of a size easily movable by the wind were by far the most common in the west bank, their place being taken by coarse gravel in the eastern one. In these sections, the black topsoil above the yellow sandy clay was in the western bank usually 2–3 times the thickness of the smaller deposit in the eastern bank. Further, faint lines of stratification could be seen as indicated by coarser vegetable remains. These facts indicate that the cumulative effects of wind and vegetation upon wind-borne materials explain in large part at least the steeper west bank of Long Island streams.

N. M. Grier

Dartmouth College

1 Jennings, O. E., Science, LV, p. 291.

2 Hayes, E., Science, LV, p. 567.

3 Davis, W. M., Science, LV, p. 478.

SCIENTIFIC BOOKS

Earth Evolution and its Facial Expression. By William Herbert Hobbs. The Macmillan Company, New York, 1921, 178 pages.

This interesting and suggestive book deals with major problems in advanced dynamical and theoretical geology. It represents the results of a long period of thought and study on the part of the author of the "fundamental questions of theoretical geology which are in one way or another connected with the growth of continents and mountains." The book is divided into fourteen chapters.

In Chapter I the field of cosmogony is traversed in a brief and general way. Reference is made to the conceptions of Greek, Latin and other philosophers of antiquity. The views of early modern thinkers are considered, together with the origin and rise of the nebular hypothesis. The author regards the objections to this hypothesis as fatal, and adheres to the planetesimal hypothesis, although in the development of his conceptions he departs markedly from certain postulates of that hypothesis.

The nature of the earth's interior is considered in Chapter II. The arguments supporting a solid, rigid and elastic condition for the earth's interior are emphasized, but a new conception is offered to explain the arrangement of denser and lighter material within the earth. It is assumed that a selective addition of meteoric (planetesimal) material obtained during the growth of the earth, resulting in a core of meteoric stone-iron, surrounded by an intermediate shell of meteoric nickel-iron, with an outer shell composed of meteoric stony matter enveloped by a skin or rind possibly less than 10 km. thick composed chiefly of sediments. It is further suggested that the central core has a radius of 3,500 km. with an average density of 6.93, that the intermediate shell is 1,700 km. thick with a density of 7.6, and that the outer shell has a thickness of 1,200 km. and an average density of 3.6.

Vulcanism forms the theme of five chapters. The author maintains that temperature and aqueous conditions are such that rocks may fuse within the earth's rind of sediments, and probably not more than six miles below the surface. It is concluded that shales constitute the source of essentially all lava, for they make up the bulk of sediments, they are very similar in composition to igneous rocks, with a range in fusibility near the temperature of lava. It is further contended that this mode of origin of lava readily explains the conceptions of "consanguinity" and "petrographic provinces."

The fusion of shale is regarded as resulting from relief of pressure following block faulting and folding. Block faulting is considered as due to compression rather than tension, the compression elevating segments, the heavier, competent strata of which tend to separate from the weaker shale members below. The lava from the fusion of the shale is squeezed out along fissures bounding the blocks by the weight of overlying rock and by the jolting effects of earthquake shocks. This lava is basic in composition, for it is derived from calcareous shale resting beneath competent limestone beds, that being the order of deposition in a transgressing sea. Later lava of andesitic and more acid types may be exuded due to extension of magma chambers downward into shale of average composition and siliceous shale.

In folding shales located in the lower part of anticlinal arches fuse as a result of the lifting of their load by stronger members involved in the fold. Continued application of lateral pressure and underturning of the folds squeeze out the magma. In this case the lava is of average composition derived from the fusion of shale of average composition, that shale being forced into a superior position in the anticline, as shown by experiment. Later fusion of lower siliceous shale would give rise to dacitic and rhyolitic lava, and the formation of secondary anticlines paralleling the principal folds would extend the lava chamber upward into higher calcareous shale, basaltic lava resulting to be extruded as a later phase of the vulcanism associated with growing mountain folds.

The author does not regard laccolites as the result of intrusion, but considers them as illustrating initial efforts towards folding, the competent strata rising in domes and shale below migrating inward to be fused in a lava pocket. The same idea is applied to the origin of sheets, and the conception is extended to the origin of batholiths forming cores of recently elevated folded mountain ranges.

Gases present in lava are all to be accounted for by the materials already present in the original shale, or by accessions secured during the ascent of the magma. The source of the atmosphere under this conception is not apparent.

Six chapters are devoted to the consideration of the earth's physiognomy. In the first of these chapters, Chapter VII, the author considers the change of figure through which the earth has passed. He follows the tetrahedral theory, a theory that has not found wide acceptance among geologists because of the mechanical difficulties in the approach to such a form by a rapidly rotating, solid, elastic spheroid. Students of historical geology will find the illustrations accompanying this portion of the text interesting even if they do not agree with the conceptions the figures are intended to convey. In the development of this chapter the author gives scant heed to the "permanence of the ocean basins," a theory he regards as untenable.

A chapter is devoted to the rapidity of geologic changes. The border zone of the Pacific and the zone traversing the Mediterranean Sea of Europe and America are considered as regions where geologic changes are going on rapidly to-day—a testimony to the rapidity of geologic changes in general, and a challenge to the orthodox view concerning the time necessary for the accomplishment of past geologic changes. Few geologists will be found to agree with Professor Hobbs in his position on this question. In fact, the investigations of the last two decades in earth genesis, historic geology, radioactivity, etc., have emphasized the enormous duration of geologic time.

The author follows Suess in dividing the continental areas into two sections, one characterized by folded structures, the other by plains and plateaus. He likewise considers the folded structures as arcs developed with convex faces and steeper sides facing oceans existing at the time of their formation, and festooned about old lands of earlier eras. The thrust responsible for the formation of the arcs, however, is

regarded as generated by a subsiding ocean floor and directed against strata near the coast, producing underthrust folds with thinned under limbs, and bordered on their outer sides by synclinal fore-deeps. The Appalachians, Rockies and other mountain systems are taken as examples. In the first case it is assumed that the thrust came from the interior (Mississippi valley) sea, not from the east as usually supposed; in the case of the Rockies the thrust came from the Cretaceous sea covering the region of the Great Plains; and the thrust forming the Coast Ranges has come from the subsiding Pacific basin. The effect of the trend of the coast lines on the shapes of arcs rising off their shores is elaborated.

In the closing chapter on physiognomy the author reemphasizes his well-known ideas regarding the intimate relationship existing between fractures and surface expression. It is pointed out that in the Great Basin province north-south and east-west fractures with their bisectrices are dominant, and Africa is regarded as divided into a fault mosaic by fractures developed in the same directions. This fracture system is also applied to southern South America, and the author concludes that this pattern of fractures is continental in extent and probably worldwide.

The conception is entertained that both fracturing and folding may go on simultaneously within the same strata, rather than limited to separate depth zones. The author does not regard the theory of a zone of fracture as distinct from a subterranean zone of flow as tenable.

The book closes with a concise survey of the field of theoretical geology in which the author enumerates the theories he regards as tenable and which are emphasized through the book, together with the theories that are rejected as not being tenable.

Albert W. Giles

University of Virginia

The Air and Its Ways. The Rede Lecture (1921) in the University of Cambridge with other contributions to meteorology for Schools and Colleges. By Sir Napier Shaw, Sc.D., F.R.S. With 100 figures, Royal 8vo, pp. xx + 237. Cambridge University Press, 1923. New York, The Macmillan Company. Price, $7.00.

Lectures and addresses on meteorological subjects are always easy to make and sometimes interesting to hear. So Sir Napier Shaw says and doubtless believes. But some of us on this side of the Atlantic can not help but qualify his statement with our own "That depends"—because of our own experience.

However, few of us can lecture or write like Sir Napier Shaw—more's the pity—and perhaps this is one reason why meteorology or to give it a modern and more suitable appellation, *aerography*,[1] makes but slow headway in university curricula.

The present volume is not a text-book. We have the author's word for that; and yet it certainly can serve as such and serve admirably in any university course on atmospherics, using this word in its general sense and not the restricted one, of irregular and unwelcomed static interferences with radio messages.

Sir Napier Shaw says frankly that the book shows meteorology (awkward word) in its workaday clothes, with loose or missing buttons here and there and the tailoring not always perfect. This may be so; but we fail to observe it; and the originality and attractiveness of the work permit no notice of defects in dress.

In the book there are essays on climatology, air physics, dynamics of the atmosphere, agriculture as dependent on weather; and much valuable historical matter.

In a brief review, these can not be dwelt upon, and it is enough to say that he who is interested in any one of these fields of applied science will find page after page of up-to-date information and stimulating discussion.

Sir Napier is himself easily the most suggestive of aerographers. In this book he brings out no less than three new lines of investigation, or, in his own words, "new meteorological principles, as inductively justified": First, the motion of the air under balanced forces; second, the *eviction* of air by turbulent motion as an inevitable concomitant of convection; and third, *stratification* in consequence of the resilience due to excess temperature. He hopes that the last will in time lead to satisfactory explanation of the formation of high pressure areas.

The book is in the main not beyond a layman's depth and seems to the reviewer to be exactly the type of book an instructor in aerography should own, read, re-read and ponder over.

Typographically, the book is beyond criticism, as well it might be, having been seen through the press by a master hand, being indeed the last work of Mr. J. B. Peace of the Cambridge University Press, the author's college friend of many years.

Alexander McAdie

ZOOLOGICAL NOMENCLATURE

The Secretary of the International Commission on Zoological Nomenclature has the honor to notify zoologists, especially icthyologists, that Professor David Starr Jordan and the U. S. Fish Commission concur in recommending the adoption of the general principle that names now current are not to be dis-

[1] Aerography, literally the air and its ways.

carded unless the data show this to be a clear cut necessity. Under this general principle, they propose that the following 14 generic names of fishes, in regard to which a difference of opinion exists, shall be provisionally legitimized with the types indicated:

Aëtobatus Blainv., 1816 (type, *Raja narinari* Euphrasen); *Conger* Cuv., 1817 (*Muraena conger* L.); *Coregonus* Linn., 1758 (*Salmo lavaretus* L.); *Eleotris* Bloch & Schneider, 1801 (*gyrinus* Cuv. & Val.); *Epinephelus* Bloch, 1792 (*marginalis* Bloch); *Gymnothorax* Bloch, 1795 (*reticularis* Bloch); *Lampetra* Gray, 1851 (*Petromyzon fluviatilis* L.); *Malapterurus* Lacépède, 1803 (*Silurus electricus* L.); *Mustelus* Linck, 1790 (*Squalus mustelus* L. [= *Mustelus laevis*]); *Polynemus* Linn., 1758 (*paradisaeus* L.); *Sciaena* Linn., 1758 (*umbra* L. = *Cheilodipterus aquila* Lacép. as restr. by Cuvier, 1815); *Serranus* Cuv. (*Perca cabrilla* L.); *Stolephorus* Lacép., 1803 (*commersonianus* Lacép.); *Teuthis* Linn., 1766 (*javus* L.).

The secretary of the commission will delay the vote on this case until one year from date, in order to give to the profession ample opportunity to express concurrence or dissension as respects any or all of these names.

C. W. STILES,
Secretary to Commission

WASHINGTON, D. C.

SPECIAL ARTICLES

NOTE ON THE THEORY OF PHOTOGRAPHIC SENSITIVITY[1]

THE very small amounts of substance involved in the formation of photographic latent images have prohibited conventional methods of chemical analysis. The ingenious attempt of P. P. Koch[2] to apply the Ehrenhaft condenser method to the initial reaction of silver bromide in light has apparently not yet given unobjectionable results. But in any case, the use of gelatin-free silver halide can not yet be regarded by the photographic chemist as significant for the gelatino-silver bromide of photographic emulsions. The generally accepted conclusion that the substance of the latent image in these consists of absorbed colloid silver has been reached by indirect methods, and is largely due to Lüppo-Cramer.[3]

Reasoning from the general principle that the fundamental photographic reaction $Ag^+ + \theta = Ag$ is autocatalytic in character, various investigators have suggested that the precursor of the latent image, the "sensitivity" of the silver halide grains, might itself be substantial in nature, and indeed actually itself colloid silver. Thus R. Abegg[4] brought forward evidence, inconclusive but suggestive, for "sensitizing" by finely divided silver. The idea that the "ripening" of silver bromide emulsions was associated with a partial reduction forming "Reduktionskeime" was advocated by J. M. Eder,[5] although this investigator regarded both the "Reduktionskeime" and the latent image as subhalides of variable composition Ag_mBr_m Ag_mBr_{m-n}. Evidence for the existence of such colloid silver nuclei in relation to sensitivity was brought forward by Lüppo-Cramer,[6] who found that the sensitivity of "ripened" emulsions could be reduced greatly by treatment with silver solvents such as a mixture of chromic and sulphuric acids prior to exposure. Again, one of the writers and A. P. H. Trivelli[7] showed that the development of latent images by fuming with ammonia, whereby a recrystallization of silver bromide on silver nuclei was effected, was accompanied by partial reduction of the halide to silver, increasing the probability that such reduction took place in the ammonia ripening of gelatino-silver bromide emulsions. The theory that sensitivity, at least in high speed photographic emulsions, is due to colloid silver was put forward in a very striking form by F. F. Renwick.[8] He suggested that the change involved on exposure of these is entirely limited to the preexistent colloid silver, which he supposed to be converted by light from a charged "sol" form to a neutral "gel" form, the former being incapable of initiating development, the latter able to act as nuclei for the actual reduction of the silver halide by developers. Quite independently, F. Weigert[9] brought forward evidence that in "printing out" with silver chloride plus silver citrate, the actual light sensitive substance was colloid silver; that this reacted initially according to the Einstein photochemical equivalence principle, one quantum $h\nu$ being photochemically absorbed per atom of (colloid) silver.

Proof or disproof of this hypothesis is equally difficult to obtain. But inferential evidence of the same character as that regarded as establishing the nature of the latent image has been obtained by the writers recently. In a recent paper[10] they have pointed out that a discrimination between the hypotheses that sensitivity is due (a) to a photocatalyst, *e.g.*, colloid sil-

[1] Communication No. 165 from the Research Laboratory of the Eastman Kodak Company.

[2] *Zeit. fur Physik*, *3*, 169–74 (1920).

[3] Das latente Bild. (W. Knapp, Halle, 1911).

[4] *Arch. wiss. Phot. 1*, 18 (1899).

[5] Cf. Lüppo-Cramer, *op. cit.*

[6] Phot. Mittl., 1909, p. 328.

[7] "The Silver Bromide Grain of Photographic Emulsions," 1921, p. 25 (Van Nostrand, N. Y.).

[8] *J. Soc. Chem. Ind.*, 1920, p. 156T.

[9] Sitz. ber. Bul. Akad., p. 641 (1922).

[10] *J. Frankl. Inst.*, 1922, p. 486.

ver, in the silver halide grains, (b) to the quantum character of light radiation in relation to size of grain,[11] might be obtained by Lüppo-Cramer's desensitizing action with chromic acid *et similibus*.

In a subsequent letter to the *British Journal of Photography*[12] it was pointed out that this required that the desensitizer be removed from the emulsion *prior* to exposure, as otherwise it might act *during* exposure by destruction of nascent latent image. By methods which will be described in a fuller communication they have shown this to be possible, and extended the desensitizing reaction to layers one-grain thick[13] for which diffusion phenomena are practically negligible, and which are susceptible of microscopic statistical investigation. With these they have succeeded in showing that the desensitizing effect is a function of grain size, being less for large than for small grains in the same emulsion. This reaction, in itself, does not necessitate Lüppo-Cramer's conclusion that the chromic acid, or other oxidizer, must be acting as a *silver solvent*. It is equally conceivable that some, perhaps reducing, substance derived from the gelatin is acting as the photocatalyst and is destroyed by the chromic acid. Lüppo-Cramer's observation that the desensitizing action becomes more and more effective as the ripening (by digestion) increases is suggestive, but not cogent, evidence for the "silver" hypothesis. He has, however, furnished another method of attack which we have employed. In explanation of the acceleration of development with certain developers by prebathing with potassium iodide,[14] Lüppo-Cramer brought forward the hypothesis of "Keimblosslegung," *i.e.*, the hypothesis that the partial converison of silver bromide to iodide made occluded colloid silver of the latent image more active. This hypothesis was contested by one of the authors and G. Meyer[15] on certain grounds which need not be recapitulated here. Lüppo-Cramer has pointed out[16] that his hypothesis does not rest on the development acceleration alone, but is more strongly supported by the following observation. If a plate is divested of the soluble non-occluded latent image by chromic acid mixture, it gives practically no image with physical (acid silver) development. If such a plate is now treated with potassium iodide and developed, a full image is obtained. This Lüppo-Cramer attributes to the "Keimblosslegung" of the occluded latent image. We have repeated these experiments in detail, and with variations to be described more fully elsewhere. Although not convinced that the "Keimblosslegung" is a satisfactory explanation of the development acceleration previously noted, we consider that Lüppo-Cramer's position in regard to the oxidation experiment is well grounded. In particular, the fact that a *repetition* of the sequence chromic acid : potassium iodide yields *no* image strongly supports the view that the first iodide treatment does set free the occluded colloid silver nuclei. Now we have applied this reaction to the *desensitizing process* with chromic acid described above, and find that treatment with potassium iodide after chromic acid gives practically the same effect as treatment with iodide alone; but a further treatment with chromic acid enormously reduces the sensitivity. The similarity of this to the reaction of the *latent image* is evident.

If the desensitizing action of the chromic acid consisted in destroying a reducing substance from the gelatin, there is no apparent reason why this should be reformed by iodide. On the other hand, if the action of such a substance consists in a slight reduction of the silver halide, some part of the reduction product, colloid silver, being occluded in the grain, it is comprehensive that iodizing would again bring it into activity, *i.e.*, to the surface of the grain.

These results are in harmony with the localization of the "sensitivity" in "spots" or "centers" on the grain, as demonstrated by Svedberg[17] and confirmed by Toy.[18] It appears that any quantum theory of exposure must be limited to collisions with sensitive spots, *probably of colloid silver*, and consisting of only a few atoms of metallic silver. A restriction of this character has been recognized as necessary by Silberstein in a modified form of his theory[19] in consequence of measurements of Jones and Schoen[20] which showed that in Trivelli and Righter's experiments some 300 quanta of λ 420 $\mu\mu$ were incident per grain of 1 μ diameter.

We may suppose that the first action of light is to release a photo-electron from the colloid silver speck. This would require less energy than to release one from the bromide ion of the $Ag^{+}Br^{-}$ lattice, owing to the strong electro-affinity here. The colloid metallic silver may be considered as a lattice of silver atoms intermeshed with a lattice of electrons, the latter being active both in conduction and photo-electrically. The free electron, having a kinetic energy $\frac{1}{2}mv^2 = h\nu$,

[11] L. Silberstein, *Phil. Mag.*, *44*, 257 (1922), A. P. H. Trivelli and L. Righter, *Phil. Mag.*, *44*, 252 (1922).

[12] *Brit. J. Phot.*, 1922, p. 51.

[13] On the technique of these, see Wightman, Trivelli and Sheppard, *J. Phys. Chem.*, *27*, 7 (1923).

[14] The so-called Lainer effect; *cf.* Lüppo-Cramer, Kolloidchemie und Photographie, 2nd Ed., p. 63 (1922, Steinkopf, Dresden).

[15] *J. Amer. Chem. Soc.*, *42*, 689 (1920).

[16] *Koll, Zeitschr.*, *30*, 186 (1922).

[17] *Phot. J.*, *62*, 186, 310 (1922).

[18] *Phil. Mag.*, 44, 352 (1922).

[19] *Phil. Mag.* (in press).

[20] *J. Opt. Soc., Am.*, 7, 213 (1923).

where ν is the wave-length of the active light, is then able to enter the silver ion, forming a neutral silver atom $Ag^{+} + \theta = Ag$, while the unneutralized bromide ion loses an electron. $Br^{-} = Br + \theta$. This chain reaction, analogous to that suggested by Bodenstein for the action of light on $H_2 + Cl_2$, would go on to a limiting state, depending on the initial energy of the photoelectron, but producing a nucleus large enough to initiate development for a developer of given reduction potential.

A fuller account of the experimental work is to be published in collaboration with Mr. A. P. H. Trivelli.

S. E. SHEPPARD
E. P. WIGHTMAN
ROCHESTER, N. Y.

A METHOD OF ULTRAMICROSCOPY WHEREBY FLUORESCENCE IN THE CYANOPHYCEAE AND DIATOMACEAE MAY BE DEMONSTRATED

AT the recent meeting of the Royal Society of Canada I demonstrated the fluorescence of the Cyanophyceae. On returning to my laboratory I succeeded by the same means in finding that nearly all diatoms which I could find are also visibly fluorescent. In this regard the pigments involved stand in contrast to chlorophyll, inasmuch as the latter when in the living cell is not visibly fluorescent save when viewed spectroscopically, or by means of ultraviolet light. Raehlmann[1] believed, however, that he could detect it in suspensions by means of the ultramicroscope, but the fact was called in question by Czapek.[2] The reason of the non-visibility of the fluorescence of chlorophyll lies in the physical relation of this pigment to its carrier, so that the complex behaves optically like an emulsion or solid solution as, *e.g.*, chlorophyll in paraffin as J. Reinke[3] showed. It is, I think, possible to detect, by the optical means to be mentioned, slight evidences of the fluorescence of chlorophyll in the chloroplasts of *Spirogyra* and in some other plants, but they are not convincing. Not so, however, the phycocyanin of the blue-green algae and a certain red-fluorescent pigment in the diatoms. The following optical conditions enable one to observe this. They furnish indeed the most astonishingly striking and beautiful object pictures of these organisms one can imagine.

The necessary condition to achieve this result is that the organisms be viewed by means of brilliant reflected light derived from a dark field condenser. This can not be done if the glass slide is of the thickness called for by the current rules of the ultramicroscopy game, since then the light which falls on the object does so from beneath, and if the object be translucent, it passes through it towards the observer. If, however, a thin slide, one, that is, about 0.8 mm. thick or less, is used, one can raise the dark field condenser sufficiently high to cause the light cone to be reflected from the upper surface of the cover glass, provided, however, that a dry objective is used. The light now passes downward, so that the object is illuminated from above, and is seen by reflected light. When blue-green algae are thus viewed, the fluorescence of many kinds becomes readily visible. In some it can be seen only somewhat faintly, because of the numerous bright granules which furnish reflecting surfaces and so produce the effect of an emulsion. If, however, the organisms be mounted in glycerin the extraneous light is obviated, when the cells glow with a fervent light with its characteristic fluorescence color. *Rivularia, Cylindrospermum,* some species of *Oscillatoria,* rich blue-green by transmitted light (ordinary microscopy) and brilliantly outlined and accompanied by diffraction images when seen at the apex of the light cone, when seen at the apex of the inverted light cone become deep crimson. By meticulously focussing the condenser and objective at the same time, one obtains combinations of outline object pictures and fluorescence of rare beauty. Other species of *Oscillatoria,* some *Chroococcus* forms, and others have a yellower or golden sheen, while a species of *Nostoc* is bright orange. The cells of *Nostoc commune* obtained by crushing a gelatinous filament from some material (from China) given to me by Professor H. M. Richards about twenty years ago, glow deeply red, while the matrix appears a pale blue, perhaps because of adsorbed phycocyanin.

The visible fluorescence in the diatoms is confined to certain vacuoles which, by transmitted light, appear a pale greenish yellow, and which take up Sudan III. The pigment may be inferred to be oil soluble, and may be a chlorophyll, with the properties of chlorophyll alpha. It is not readily destroyed by heating, as is phycocyanin. Because of the numerous sources of reflection, the fluorescence can not be seen, or certainly can be seen only with difficulty, unless the material is mounted in glycerin. When thus viewed, the vacuoles, seen as blood-red, stand out in some species with great clearness. In *Navicula* there are two large vacuoles (as currently described) one on either side of the nucleus with its surrounding cytoplasm. Generally two smaller fluorescent vacuoles occupy the ends of the cell. In *Meridion* when small there may be but one large vacuole. In larger cells three smaller ones may occur. A circular colony of

[1] Raehlmann, E. Neue ultramikroskopische Untersuchungen über Eiweiss, etc. *Arch. ges. Physiologie,* 112: 128. 1906.

[2] Biochemie der Pflanzen. *1*: 564.

[3] Die optischen Eigenschaften der grünen gewebe, etc. *Ber. d. D. B. G.* 1: 395. 1883.

this organism with its green chloroplasts and intermingled red fluorescent vacuoles vies with a jewel set with emeralds and rubies for beauty.

Some of the *Pleurococcaceae* undoubtedly also are visibly fluorescent. I cite *Scenedesmus* and *Raphidium* (or it may be *Selenastrum*) as examples.

The best results are obtained with a cardioid dark field condenser, and when one is especially studying colors, an arc light. A 400-Watt condensed filament lamp serves well enough otherwise. Water instead of oil does between the slide and condenser, obviating messiness. I venture to believe that, when the above results are experienced, the use of the dark field condenser will be widely extended. Some of my own observations, accompanied by discussion thereupon, will appear in the forthcoming proceedings of the Royal Society of Canada.

The method of making use of the reflected hollow light cone derived from the dark field condenser has, I think, not consciously been taken advantage of. It very greatly enhances the value of this optical apparatus, as I have already found. The first sight of these fluorescent organisms invariably calls forth expressions of delight, and the experience recalls one's childhood days when the wonders of the microscope were real wonders.

FRANCIS E. LLOYD

McGILL UNIVERSITY

QUOTATIONS

RESEARCH AS A PROFESSION

TOWARDS the end of last February Sir Alfred Yarrow gave £100,000 to the Royal Soicety to mark his sense of the value of research to the community. He gave it to be used as capital or income, as the council of the society might think fit, because he recognized "that conditions alter so materially from time to time that, in order to secure the greatest possible benefit from such a fund, it must be administered with unfettered discretion." To emphasize this point Sir Alfred Yarrow suggested that any rules made for the administration of the fund should be reconsidered by the council every tenth year, so as to meet modern needs. While leaving the council this valuable discretion, he expressed his hope that the money would be used to aid scientific workers by adequate payment, and by the supply of apparatus or other facilities, rather than upon erecting costly buildings on which large sums of money are sometimes spent without adequate endowment, so that "the investigators are embarrassed by financial anxieties."

The council of the Royal Society has given attention to the best way of using Sir Alfred Yarrow's gift, and has this week published the result of its deliberations. The official announcement states that on reviewing the situation it appeared to the council "that there was a marked deficiency of positions in which a man who had already proved his capacity could continue to regard research as the main occupation of his life. Consequently at the council meeting of the fifth inst. it was finally decided to use the larger part of the income in the direct endowment of research by men who have already proved that they possess ability of the highest type for independent research. To this end a number of professorships will be founded, of type similar to the Foulerton professorships, which were founded by the society in 1922 for research in medicine. The professors will be expected to devote their whole time to scientific research, except that they may give a limited course of instruction in the subjects of their research to advanced students. There is at present a tendency to regard scientific research as a secondary occupation for men whose primary occupation is the teaching of students. The intention of the Royal Society in founding these professorships is to recognize research as a definite profession."

We make no doubt that the council of the Royal Society has rightly interpreted Sir Alfred Yarrow's wishes, and it will be observed that the two gifts which have recently been received by it—the Foulerton and Yarrow funds—have enabled it to establish a precedent new in this country at least, and not very common in any other. This new precedent is that research shall be the primary object of the incumbent of one of these professorships, and not, as has usually of necessity been the practice, an occupation secondary to the teaching of students. Sometimes, it is true, the occupant of a university chair has put research first and teaching second, but as it is his duty to teach, the university authorities may be disposed to grumble—not without some reason. No doubt the stimulus provided by a class of students is useful to some men, but, as Sir George Newman has more than once reminded us, the art of teaching requires special training and, perhaps even more, a special aptitude. A man may be an excellent teacher—many examples will come to mind—and not good at research work. The converse also is true. The two aptitudes do not always exist together, and there have been great scientific investigators who had no aptitude for teaching, except by example to a chosen few who assisted in the laboratory. The result of the great experiment the Royal Society is now able to conduct will not be known perhaps for a generation, but in its hands, and administered, as the donor desires, "by the best people from time to time available," there can be no doubt that the scheme must have a favorable influence on the progress of science in this country.—*The British Medical Journal.*

SCIENCE NEWS

THE CALIFORNIA EARTHQUAKE

Science Service

To scientists in Washington the earthquake that shook southern California on the night of July 14 was not unexpected.

Because of the faults in the earth's crust near San Bernardino, Dr. Arthur L. Day, chairman of the advisory committee in seismology of the Carnegie Institution of Washington, stated that that region was known to have acquired strains in its crust that needed the sort of relief that an earthquake provides.

The famous San Andreas rift, which extends for six hundred miles through the Coast Ranges of California, runs about five miles northeast of San Bernardino. This same slipping plane runs through San Francisco and it is along this fault that the great quake of 1906 occurred. That famous earth movement covered a stretch of about 150 miles with San Francisco in the middle.

"South of that stretch for about 300 miles there has been no movement since 1857 when there was a severe shock, the mark of which may be traced across the desert plains like an irrigation ditch," Professor Bailey Willis, California earthquake expert, who is now returning to America after making a study of the Chile earthquake of last year, said in a Science Service statement in January last. Still further south there have been several recent shocks, but none of great violence. In the same statement Professor Willis said that "there is evidence of considerable activity in the section east and south of Los Angeles." This corresponds to the region that has just suffered a shock.

The map of California earthquake conditions soon to be published by the Seismological Society of America shows another active fault in the earth's crust just southwest of San Bernardino.

The Coast and Geodetic Survey is making precise maps of California which will aid in the prediction of these natural occurrences, but their surveys have been confined so far to the northern part of the state. Scientists connected with the Carnegie Institution, Stanford University and other institutions are also working on the problem.

Other shocks in the same area are to be expected, according to Professor W. J. Humphreys, seismologic expert of the U. S. Weather Bureau, although they will probably not be so violent as the first shock. A series of slight disturbances following the initial quake is the general rule.

A NEW MINOR PLANET

Science Service

A NEW member of the solar system, an asteroid, has been discovered by Professor George H. Peters, of the U. S. Naval Observatory. He occasionally finds such small planets on his photographic plates as a by-product of his regular observations. But the one that Professor Peters has just announced is extraordinary in that it is very close to Edburga 413, an asteroid previously known and whose return to visibility was predicted by computations. Both Edburga and the newcomer are about the same magnitude, a little more than 12, and have approximately similar apparent motions. Only the telescope can detect them; they are found by their motions in the sky with respect to the fixed stars.

"I am not quite sure of the identifications," Professor Peters stated. Only additional observations over a considerable period will settle the question of which is which on account of the similarity of motion and brightness. One of them is Edburga; the other can not be found listed in any of the catalogues and Professor Peters believes it to be a part of the heavens previously uncharted.

The coincidence of two minor planets so alike and so near each other he characterized as very remarkable. For twenty years he has been observing and discovering asteroids and this is the first case of apparent duplicity that he has discovered.

The discovery was made on the photographic plates of the heavens that Professor Peters takes with the 10-inch refractor telescope of the Naval Observatory.

In December, Professor Peters found another tiny planet that had been "lost" for fifty years. Its name was Aethra 132 and it was last seen in 1873 by its discoverer, Professor J. C. Watson, of the University of Michigan.

The Indians that once roamed the city of Washington were remembered by Professor Peters when he named an asteroid discovered by him on November 21, 1921, with the old tribal name of Anacostia. The new planet just discovered is still too young to be named, Professor Peters believes.

Both of these asteroids now under observation by Professor Peters are believed to be about twenty-five miles in diameter and they shine by reflected light similarly to the larger members of the planet family. They are twirling around the sun in orbits that lie between Mars and Jupiter.

HEALTH RECORD FOR 1923

Science Service

THE general health record during the first half of 1923 was more than satisfactory, Dr. Louis I. Dublin, statistician of the Metropolitan Life Insurance Company, reports. Following a most unpromising beginning, chargeable wholly to the influenza outbreak of the early months of the year, a consistent improvement has since been in evidence. At the end of the half year, the death rate of the millions of white policy holders of the Metropolitan Life Insurance Company was only one third of one per cent. in excess of that for the corresponding period of 1922. For the colored policy holders, the increase was 4.2 per cent. These small differences are very encouraging, coming as they have in the face of high influenza-pneumonia mortality during the first three months. The

SCIENCE

VOL. LVIII AUGUST 10, 1923 No. 1493

CONTENTS

SCIENCE: A Weekly Journal devoted to the Advancement of Science, edited by J. McKeen Cattell and published every Friday by

THE SCIENCE PRESS

Lancaster, Pa. Garrison, N. Y.

New York City: Grand Central Terminal.

Annual Subscription, $6.00. Single Copies, 15 Cts.

SCIENCE is the official organ of the American Association for the Advancement of Science. Information regarding membership in the association may be secured from the office of the permanent secretary, in the Smithsonian Institution Building, Washington, D. C.

Application made for transfer of entry as second-class matter to the Post Office at Lancaster, Pa.

THE STATISTICAL SIGNIFICANCE OF EXPERIMENTAL DATA[1]

WHEN a few days ago your secretary, Mr. W. T. Bovie, acting on pressure from your chairman, Mr. J. S. Hughes, urged me with their well-known energies to speak in this symposium they left me little chance to refuse. As I understand the circumstances I am a sort of "pinch hitter" for Mr. J. Arthur Harris, whose long-continued biometric studies would clearly indicate him for this place, but whose absence in the south made it necessary to find a substitute. From him you might reasonably have expected a home run; you must be content with me if I bunt out a one-bagger just to keep the game going.

I should have liked to have more time for preparation. The literature upon the statistical aspects of feeding experiments is not microscopic and the data available for statistical study are extensive. Moreover, my Yale training received here twenty odd years ago under J. Willard Gibbs was not such as to make comfortable for me the presentation of somewhat hastily collected notes. There was not in those days the fervid impatience in science that has developed in recent times in some quarters, and Gibbs himself was a model to any young man not only in his scientific thinking but in his modest and painstaking contemplation of some of the most intricate problems of nature—statistical problems. It may not be amiss if I quote these words from the preface of his last great work entitled "Elementary Principles in Statistical Mechanics" written in 1901:

> We avoid the greatest difficulties when giving up the attempt to frame hypotheses concerning the constitution of material bodies, we pursue statistical inquiries as a branch of rational mechanics. In the present state of science, it seems hardly possible to frame a dynamic theory of molecular action which shall embrace the phenomena of thermodynamics, of radiation, and of the electrical manifestations which accompany the union of atoms. Yet any theory is obviously inadequate which does not take account of all these phenomena. Even if we confine our attention to the phenomena distinctly thermodynamic, we do not escape difficulties in as simple a matter as the number of degrees of freedom of a

[1] An address prepared by request as part of a symposium on feeding experiments held by the Biochemical Section of the American Chemical Society, meeting in New Haven during the week of April 2–7 in connection with the dedication of the new Sterling Chemical Laboratory of Yale University.

diatomic gas. . . . Certainly, one is building on an insecure foundation who rests his work on hypotheses concerning the constitution of matter.

Difficulties of this kind have deterred the author from attempting to explain the mysteries of nature, and have forced him to be contented with the more modest aim of deducing some of the more obvious propositions relating to the statistical branch of mechanics. Here, there can be no mistake in regard to the agreement of the hypotheses with the facts of nature, for nothing is assumed in that respect. The only error into which one can fall is the want of agreement between the premises and the conclusions, and this, with care, one may hope, in the main, to avoid.

How very antiquated this sounds to-day when for much of the past two decades the members of the American Chemical Society have been listening as they have this very week to numerous attempts to frame hypotheses concerning the constitution of material bodies, however insecure a foundation such hypotheses may have appeared to Gibbs. The mysteries of nature which Gibbs left somewhat to one side as beyond his modest aim were, however, the mysteries of inorganic nature. Yet in this section of your society we face the vaster difficulties of organic nature, of living matter, and in this symposium the mysteries of *nurture*. It is doubtful if we may hope even with all due care to avoid, in the main, a falling into error. We are confronted with variability of feeds, however carefully we may try to uniformize them, with variation in the experimental animals, however so carefully we select them, with inadequacy of statistical material, no matter how diligently we collect the data. It is necessary to bring to bear every possible check, to exercise all conceivable care in judgment, and yet withal to be modest in our conclusions.

One check, one basis for judgment which we have to-day we did not have in readily available form a quarter century ago. The statistical method in biometrics was just then gaining headway at the hands of Pearson and his incipient school. I remember very clearly with what interest and instruction I read those early papers of Pearson while studying the statistical method with a brilliant young Yale economist in the years 1899–1902. They seemed to open up large possibilities for a scientific basis of political economy quite different from that other scientific method followed by Walras, by Pareto and by Irving Fisher in one of his notable early papers. On the whole, however, it is my judgment that up to the present time it has been not the economist but the student of biology who has most availed himself of these newer statistical methods; it would be interesting to ponder the reason why.

I have been asked to define certain terms and illustrate certain calculations employed in the statistical treatment of experimental data, and this I shall presently do. But in the first place I wish to make some general comments on the philosophy of the statistical interpretation of experimental data. A method is a dangerous thing unless its underlying philosophy is understood, and none more dangerous than the statistical. Our aim should be, with care, to avoid, in the main, erroneous conclusions. In a mathematical or strictly logical discipline the care is one of technique; but in a natural science and in statistics the care must extend not only over the technique but to the matter of judgment, as is necessarily the case in coming to conclusions upon any problem of real life where the complications are great. Over-attention to technique may actually blind one to the dangers that lurk about on every side—like the gambler who ruins himself with his system carefully elaborated to beat the game. In the long run it is only clear thinking, experienced feeling and a patient poise, not automatic systems and methods, that win the strongholds of science—witness the lives and works of those founders of two branches of chemistry of prime importance to this biochemical section: Gibbs in physical chemistry and Pasteur in the chemistry of life.

If you undertake to measure a room for wallpaper, or a court for tennis, you take some simple measuring device and proceed. You determine the measures needed. You may repeat the work as a check but not for the purpose of averaging the results. There is nothing statistical in your mind. The same is true for all our ordinary weights and measures; we weigh and measure; we may check or get somebody else to check the result, we do not average. When a finer or more accurate measure is needed we have recourse to a better or more sensitive instrument; if none can be had with sufficient sensitivity we may even resort to devising one. Generalizations are unsafe, but I will venture the guess that it is always our ideal to have at hand instruments that will enable us directly to read the measures desired and thus spare us the statistical method of analysis. The history of the development of physics has been constantly attended by the conflict between the more accurate instrument and the call for the ever more precise determination of physical properties of matter.

But the time seems always to come when the necessary precision transcends the available appliance. This time came early in the refined measures of astronomy, and already a hundred years ago the treatment of astronomical data was statistical. The most careful measures were most carefully and patiently repeated and the resulting mass of material was reduced by the method of averages and of least squares. The errors or departures from the mean were all small, for the simple reason that the observational

methods and the objects observed were of such a nature that a high degree of precision was directly attainable. Such small deviations as remained to be reduced by statistical treatment were due to a large number of forces or causes each of which if operating alone might produce a considerable irregular and asymmetric variation in the observations, but which were balanced in such a way that the actual deviations were not only small but had a high degree of symmetry and lawfulness. It was under such circumstances that the so-called normal law of errors, proposed and discussed by Laplace about the time that Gauss was learning to walk, came into general use. The law is often called Gauss's law and is figured geometrically as you all know by the bell-shaped probability curve (Fig. 1).

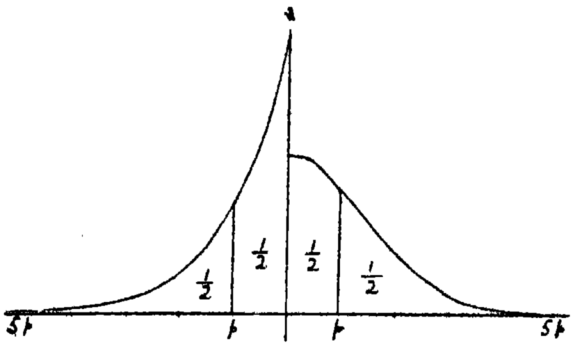


FIG. 1. On the left is Laplace's frequency curve; on the right is Gauss's. The curves are here plotted to a scale which makes the actual probable error p the same; the areas under the two curves are equal and each is divided into two equal parts by the vertical ordinate at p. Each curve should be reproduced symmetrically on the other side of the central vertical line, but the drawing is clearer when only one half of each curve is shown.

During the past century and a fraction a large number of alleged proofs of the normal law of errors or deviations from the arithmetic mean have been proposed and a variety of theoretical objections to it have been propounded. Bertrand brushes aside alike proof and objection with the statement: "Gauss's formula should be adopted. Observation confirms it; that is sufficient for its applications. Its consequences minutely examined are always found accordant with the facts." He is writing, be it clearly understood, from the viewpoint of the astronomer or physicist engaged in precise measurements many times repeated. Indeed, under these conditions we must even recognize the validity of theoretical criteria which may be applied to any such set of data to determine whether or not they are bona fide or have been retouched. Moreover, it is astonishing to find by experience how few observations will serve as a large number. I well remember an experiment I performed with a mirror galvanometer. Some 15 readings were taken to establish a mean. As is always the case, the galvanometer was moving somewhat erratically, due to a large number of conflicting forces—air currents, changes of temperature, electric cars passing in the distance, etc.—despite an effort carefully to shield the vitals of the instrument from external influences. Some of the readings were seemingly unduly far from the mean, and yet if they were discarded the results would not so well accord with the theoretical checks and would tell the tale of presumptive experimental dishonesty. It would have been interesting to apply such criteria to Dr. Cook's famous polar observations; it would take a deal of trouble so to fake the observations as to avoid detection.

So excellent were the results of Gauss's law that many came to believe that it was of wider applicability than either its philosophical premises or its experimental verifications warranted. One of the triumphs of modern statistical theory has been the return to the more general consideration of Laplace and our emancipation from the tyranny of a law too restricted to serve in biometrics. True, there are some fields in which a close observance of the normal law is revealed, as in the distribution of heights among the members of a large population. But little as we know about the true cause of the specific height of any one of us we do know that many major, more or less independent, causes are at work, that these are balanced effectively about a mean from which the deviations are reasonably small. There is no obvious reason why the distribution of Gauss should not apply.

The matter is very different if we study the length of our lives instead of that of our bodies. The frequency distribution of the ages at death among a large population is a reasonably definite affair of undoubted major biological significance; but the curve is not symmetric and has little similarity to that of Gauss. According to the American Experience Mortality Table starting with 100,000 persons alive at the age of 10, the number of deaths per annum is about 750 the first year, decreases slowly to about 720 at the age of 27, increases to about 1,000 at 50 years, and then rapidly to a maximum of 2,500 at the age of 73, from which it falls rapidly to zero in the next 25 years. Now the length of our life surely depends, like the length of our bodies, upon a large variety of conflicting causes, but they do not produce a symmetrical balance about a mean nor are the deviations from the mean small in the sense that they are in precise physical observations or even in the case of our stature. The law of Gauss is plainly contra-indicated.

Although many of the frequency distributions of life are asymmetric and although the general theory

of curve fitting is of importance in biometry and will in due time become important even for such elementary matters as the statistical study of data resulting from feeding experiments, we shall restrict ourselves here to symmetrical laws wherein the chances of positive deviations are equal to the chances of negative deviations of the same magnitude. And of the symmetric laws other than Gauss's one of the most interesting is the first law of errors or small deviations ever proposed. It was put forward by Laplace in 1774 four years before he suggested the normal law. Let us measure deviations not from the arithmetic mean but from the median, that is, from that datum which stands in the middle of a series of observations arranged according to magnitude. The median or middle datum is much used in economic studies instead of the arithmetic mean and in many ways is simpler to use. Now if d be the deviation from the median, Laplace's suggestion is that the frequency of occurrence of a deviation of magnitude d is proportional to

$$e^{-kd} = \frac{1}{(2.718\ldots)^{kd}}$$

In the figure we have on the right the normal law and on the left the law of Laplace. It should be observed that each of the curves should be reproduced symmetrically on the other side of the vertical line, because both are symmetric; but this would complicate the figure. Note that both laws make small deviations much more frequent than large ones, as is ordinarily the case in symmetrical laws. But the Laplace law begins to fall off rapidly and falls off steadily more slowly; whereas Gauss's begins by falling off slowly, then falls faster and finally falls slowly again. The relative numbers of deviations which lie between definite limits are measured by the area under the curve between verticals; and if a vertical be drawn at such a point that the whole area to one side of the middle line is cut exactly in two the deviation represented by that position is called the *probable error* or *probable deviation p*. This is a technical term which in common parlance means merely that the betting is even as to whether a deviation will be greater or will be less than the probable deviation—that in the long run there will be as many deviations larger as there are smaller than this. The curves have been drawn in such a manner that the probable deviations are equal.

As the curves are constantly falling off with increasing deviations, the areas under the curves, toward the right or toward the left as the case may be, are also diminishing and the chances of really large errors are very small. It is customary to take as the unit of reference the probable deviation. The following table shows the chance of deviations being greater than 1, 2, 3, 4 or 5 times the probable value p.

TABLE I

Chances of a deviation greater than 1, 2, 3, 4, 5 times the probable

Laplace's Law		Gauss's Law	Tchebycheff's Criterion
$1p$	.5000	.5000	....
$2p$	.2500	.1773	less than 0.550
$3p$	.1250	.0430	" " 0.233
$4p$	.0625	.0070	" " 0.137
$5p$	.0312	.0007	" " 0.088

This table shows how fast the chances of large deviations diminish; it shows further how much faster they diminish under the normal law (Gauss) than under Laplace's first law. Only about seven observations in 1,000 can be greater than four times the probable deviation on the so-called probability law; whereas 62 observations in 1,000 may be greater on Laplace's law.

I desire to lay some stress on this table and the inferences from it, because biometricians test the statistical value of a magnitude by reference to the size of its probable error. Statistically determined magnitudes are written followed by a plus or minus sign ($\pm$) and by their probable errors. Thus $x = 12.73 \pm 0.27$ means that the quantity x has been determined by statistical processes, such as averaging, to have the value 12.73 and that the probable error of the determination is 0.27. Or it is even betting that the true value of x lies between $12.73 - 0.27 = 12.46$ and $12.73 + 0.27 = 13.00$. If now we have evidence that the law of the frequency of the distributions is Laplace's second law (the law of Gauss), we may go further and say that the chances are only 43 in 1,000 that the quantity x lies outside the limits defined by thrice the probable error:

$$12.73 - 3 \times (0.27) = 11.92 \text{ and } 12.73 + 3 \times (0.27) = 13.54.$$

Odds of $1{,}000 - 43 = 957$ to 43 or better than 22 to 1 are so high that they represent a reasonable degree of certitude and consequently, when the probable error of a magnitude is less, particularly when it is much less, than one third of the magnitude itself we conclude that the magnitude is statistically significant.

Such a conclusion for its cogency depends tacitly on the fact, if it be a fact, that the chances of large deviations fall off very rapidly with the increase in the deviation as is the case with Gauss's law. On Laplace's law there is not merely one chance in 23, there is one chance in eight that an error exceeds thrice the probable error. If the frequency distribution is unknown, the chances of large deviations are likewise unknown and there is no safe theoretical ground on which those chances can be estimated by

the values set down under Gauss's law in the table. There is a theorem due to the famous Russian Tchebycheff which states that the error in an average value does not exceed a multiple mp of the probable error oftener than once in $2.2/m^2$ times. In the table I have inserted Tchebycheff's Criterion to show how pessimistic he is as to the certitude of statistical inferences in comparison with Gauss. Why is it, then, that biometricians, who deal with material often scanty and of great complexity and diversity of law and with errors neither small nor symmetric, place such confidence in the probable error that a deviation of thrice the probable is regarded as almost impossible and a deviation of four times the probable as quite impossible?

Adequately to answer this question would require an elaborate behavioristic study of biometricians, and I fear that as laboratory animals they would be such varied and variable material that the probable errors of the results would be comparable in magnitude with the results themselves, so that any statistical inference in answer to the question would be illusory. But you can not treat a scientific man or his work exclusively or even largely by the statistical method; the question of judgment must be considered. A scientific investigator, particularly one of the leaders, develops a feeling for his work, an experience in it, and a judgment often so sound that his conclusions merit our most respectful confidence even when those conclusions are apparently founded on very little else than the investigator's intuition. The mature "hunch" of a genius is better than many a scientific demonstration. And it is undoubtedly the experience and belief of many statisticians of the first water that somewhere between three and four times the probable error comes the safe point in drawing conclusions. I mean the safe point for them.

Let me tell you a story of the great astronomer William Herschel. He desired to know the direction of the sun's motion in space. This is a statistical problem; for by the motion of the sun in space is meant its motion relative to the rest of the stars, of which there are many millions visible to our telescopes. Now Herschel had a keen personal acquaintance with the stars and selected with great judgment just seven with respect to which he would determine the solar motion. It would be a rash young statistician who would maintain that seven stars were enough to constitute a fair sample of the sidereal universe for any statistical purpose. Yet Herschel determined the direction of the solar motion with what has proved to be marvelous exactness. We may allow something for luck, but we must not too much discount the efficacy of a Herschel's intuition in the selection of material.

I must now come to some methods of statistics. For illustrative material I shall use certain data supplied to me for the purpose by one of your members from his experiments on feeding pens of guinea pigs raw and variously processed milk in an effort to determine the influence of various methods of treating on the vitamin C content of milk. There were a great many trials involving 8 or 12 pigs each and 144 pigs in all. Let me take the data on boiled milk from one run. There were eight pigs. The first column gives their weight at the start, the second the number of days before scurvy developed. The numbers in the second column are added together and divided by the number (8) of pigs to find the mean length of time (18.75 days) before scurvy developed on the boiled milk ration. The third column gives the deviations of the individual numbers of days from this mean, and the fourth column the squares of these deviations. Means are found also for these two columns.

TABLE II

Weight at start	Days to scurvy	Deviation from mean	Deviation squared	Statistical constants
222	19	0.25	0.0625	$M = 18.75$
205	17	1.75	3.0625	$\delta = 0.875$
185	17	1.75	3.0625	$\sigma = 1.199$
185	19	0.25	0.0625	$p = 0.809$
190	19	0.25	0.0625	$E_m = 0.286$
370	21	2.25	5.0625	$E_\sigma = 0.202$
335	19	0.25	0.0625	
195	19	0.25	0.0625	
Sum	150	7.00	11.5000	
Mean	18.75	0.875	1.4375	

The mean deviation is $\delta = 0.875$ days, the mean square deviation is $\sigma^2 = 1.4375$. The square root of the mean square deviation is called the *standard deviation*; in this case its value is $\sigma = 1.199$. The probable deviation has been defined geometrically on the (symmetric) frequency curve; it has also been defined for that case as that deviation than which the greater are equally numerous with the lesser deviations in the long run. As nothing is known relative to the ideal frequency distribution in this experiment other than the information given by the data themselves we must fall back on a formal arithmetic definition which is as follows: The probable deviation is $p = 0.6745\,\sigma$. This is merely the numerical relation between the probable deviation p and the standard error σ when the observations are infinitely numerous and distributed according to Gauss's law. If the true law of distribution of the data were not Gaussian the value $p = 0.6745\,\sigma$ might have small relation to the true probable error. For example, if the true law were Laplacean, the actual probable error would be not $0.6745\,\sigma$ but only $0.49\,\sigma$; the use of the arithmetic definition would give a probable error too large which

fortunately would be on the safe side (the figures in the first column of Table 1 would be 0.387, 0.150, 0.058, 0.022, 0.009, approximately, instead of the value given, but even these are far larger than the figures in column 2). The value of the individual observations may be written

$$\text{days} = 18.75 \pm 0.81; \quad \text{or} \quad 17.94 < \text{days} < 19.56.$$

The number of days it took to develop scurvy should lie half and half within the limits 17.94 and 19.56. The actual division is 5 within and 3 outside—pretty good. The largest deviation is 2.25 which is less than thrice the probable deviation, and although a deviation so large will occur according to the Gaussian law in the long run only once in 16 times (instead of 8), this need not disturb us.

Having calculated the standard deviation σ we may use the formulas applicable to the Gaussian distribution and write, if n be the number of observations (here 8),

$$E_M = \text{probable error in the mean} = 0.6745 \frac{\sigma}{\sqrt{n}}$$

$$= 0.6745 \frac{\sigma}{\sqrt{8}} = 0.286$$

$$E\sigma = \text{probable error in the standard deviation}$$

$$= 0.6745 \frac{\sigma}{\sqrt{2n}} = 0.202$$

The probable error in the mean is the probable error in the individual observation divided by the square root of the number of observations. This is a definition because it does not apply to all frequency laws, and as we shall see has no relation whatsoever to the experimental results now under examination. In like manner the probable error of the standard deviation σ is the probable error $(0.6745\,\sigma)$ of the individual observations divided by the square root of double the number of observations. These results should be written as

$$\text{the mean } M = 18.75 \pm 0.29,$$

$$\text{the standard deviation } \sigma = 1.20 \pm 0.20.$$

Now we have another set of data obtained in another trial on boiled milk. Omitting the details of the calculations, the results for the mean, the standard deviation and the probable error in the mean are:

$$M' = 13.75, \qquad \sigma' = 6.58, \qquad E'_M = 1.29$$

The difference of the means in the two runs is

$$M - M' = 5.00 = 17 \times (0.29).$$

The second trial gives a mean 17 times as far removed from the mean in the first trial as the probable error in that mean. Shall we say that this positively could not have happened? Or shall we say that the statistical method positively can not be applied here as per rule? Even if we use the much larger error of 1.29 figured from the data in the second case, the difference $M - M' = 5.00 = 4 \times 1.29$, nearly, and this can happen less than once in 20 times—according to the rule, which we don't believe (Table I, second column, Gauss's Law).

I have taken the data on the time to develop scurvy when the milk is boiled. There are three sets on raw milk, with these values:

$$M_1 = 43.00 \pm 2.78,$$

$$M_2 = 20.71 \pm 1.36,$$

$$M_3 = 27.00 \pm 2.18.$$

Taking the largest possible error of 2.78 we find that

$$M_1 - M_2 = 22.29 = 8 \times 2.78,$$

$$M_1 - M_3 = 14.00 = 5 \times 2.78.$$

According to the rule there are 7 chances in 10,000 for M_3 to be so far from M_1 and an almost incalculably small chance for M_2 to be so far away. Those who know the laws of the multiplication of chances can perhaps figure what is the chance by rule that both M_2 and M_3 shall be so far from M_1. What is the conclusion? I say beware of probable errors or rather of the mere formal application of them to meager statistical material. Your conclusions will almost certainly be wrong. The sound conclusion from the fact that the means of the different runs fail to lie reasonably close together is that the data are statistically inconsistent or insignificant. Permit me to refrain from defining the coefficient of variability—we have already too many definitions.

I know only one thing about feeding experiments—namely, that I eat what I like when I please and that my weight has remained between 157 and 167 pounds since before I left Yale in 1907. That is scanty foundation for participation in this symposium. I do not wish to give the impression that the data submitted to me for criticism are valueless; for all I know they may show just what it was hoped they would show; perhaps the experiments only meant this for a preliminary study wherewith to get his bearings—such studies are often necessary. As statistical material the individual runs, of which there are seventeen, show by their mutual comparison (as illustrated above) that for some reason they are inadequate statistically. Is it that 7 or 8 or even 12 pigs are too small a sample? If the animals in the time required to develop scurvy were as homogeneous as galvanometer deflections under good conditions these numbers would show no such inadequacy. As probable errors, according to the rule, vary inversely with the square root of the number of animals, must we take 800 pigs in a series, hoping thereby to reduce the errors to one tenth of their present values? "Pigs is pigs" would then be our only hope.

Looking over the data as a whole I have come to certain tentative statistical conclusions. Out of 144 pigs 3 starved to death sooner than drink milk, and all but 6 others, that died in brief periods, developed

scurvy in from 8 to 58 days on a diet of milk, whether processed or raw. I judge that guinea pigs were not made for a milk diet. If one could find laboratory animals which would live to a ripe old age on raw milk but go scurvy on treated milk he would, I should think, have a more desirable stock for this experiment. How about that very popular laboratory animal—Drosophila? Would the white rat do? One may be venturing too far afield in using guinea pigs. My choice would be Drosophila if possible. And why? Because the strains are pedigreed; they can be made to order, so to speak; the infinite variety of nature can be somewhat controlled in them. With a controlled pedigreed animal, mated brother to sister, and used in the F_1 generation only, one might hope to approach the narrow and reproducible experimental conditions of the physicist and chemist. In that recent and most interesting book which you have all just read, "The Biology of Death," by Raymond Pearl, you can even find a life table for Drosophila and thus make something of an allowance for natural death that might otherwise complicate lethal experiments on feeding. There is a cumulative value to Drosophila.

However, it may be possible to use guinea pigs despite their obvious aversion to milk. But in their use we should try to attain as great genetic or constitutional homogeneity as possible. First as to weights. The 144 pigs under consideration varied in weight from 420 to 132 grams. This is all too much variation. It may conceivably not be important what the weight is, and yet unless the indifference of weight has been clearly demonstrated we should restrict ourselves to pigs of approximately the same weight. Second, there is the matter of age. I have no idea what the variability of ages was nor whether it has been shown that age is a matter of indifference in its effect on the time required to develop scurvy. Still, it is safe to strive for homogeneity in the material, to reduce so far as may be the number of variables. Now as to weight I have done one very simple thing. I have taken all the pigs fed on raw milk except the one that would not drink it; there were 23 of them. I made a chart by plotting "days to scurvy" vertically and "weight at the start" horizontally—and lo! a strong correlation stared me in the face (Fig. 2).

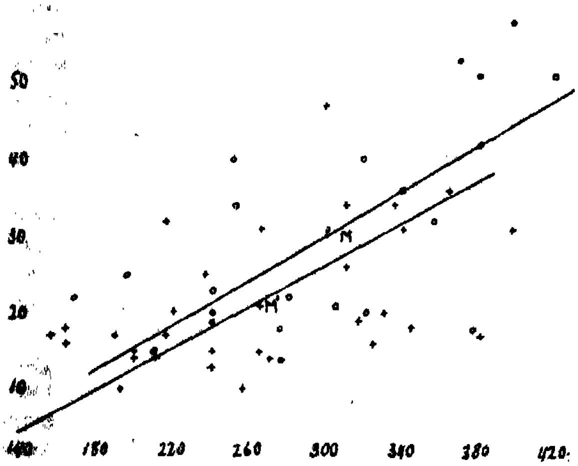


FIG. 2. A correlation diagram showing the tendency of the number of days (required to develop scurvy) to vary with the weight of the guinea pig at the start of the experiment. The abscissas (140–420) are the initial weights; the ordinates (10–50) are the number of days in which scurvy developed on a milk diet. Each circle represents these data for a single pig fed on raw milk and the upper line gives the general trend of these circles, M being the mean point. Each cross represents the data for a single pig fed on both pasteurized milk and the lower line gives their trend, M′ being the mean point. One may not compare the vertical distance between the means M and M′ without making allowance for the horizontal displacement between them.

It would take too long to define a correlation coefficient. In the "Biology of Death," pages 168–169, Pearl gives the definition in simple language for the intelligent οἱ πολλοί who frequent the Lowell Institute lectures. Suffice it here to state that the coefficient I found is $r = 0.68 \pm .07$. This is a high correlation and a small error. If I dared imitate Pearl on page 169 I should say that, the ratio of the probable error 0.07 to the coefficient 0.68 being over 9, the odds against such a correlation having arisen from chance alone are about 350,000,000 to 1; but I am too timid to follow him so far. It is enough for my purposes to note that the correlation is high and well established. I will not weary you with lines of regression or lines of closest fit, I have not calculated them. The diagram shows at a glance that for pigs fed raw milk, judging by this sample of 23, an addition of 100 grams in weight prolongs the time to develop scurvy by something like 15 days. This shows that the pigs should be uniform in weight or that the experimental data should be corrected for weight. It is not inconceivable to me that had I the ages of the pigs I should run into another correlation.

All the data for the 31 pigs fed bottle pasteurized milk were plotted up in like manner. The spread of points was again indicative of a sensible correlation coefficient, but I have not computed it nor estimated the correction for weight (except as one may do so roughly by glancing over the plotted points and guessing at a trend line). This should be done for each kind of treatment of the milk. One thing more I did. I figured the mean for raw milk and its probable error from the 23 available pigs and that for bottle pasteurized milk from the 31. The results were:

Raw $M_R = 30.65 \pm 2.4$ days. Avg. wt. $= 299$.
Bot. Past. $M_B = 21.4 \pm 1.0$ days. Avg. wt. $= 264$.

Without any correction for weight, the difference in the means, $M_R - M_B$, is 9.2, which is less than 4 times the probable error of M_R and as such would be just barely significant statistically when one considered the heterogeneity of the data and the great changes from sample to sample. An allowance for the difference of 35 grams in the average weights might easily reduce M_R to around 25 or 26 days and unless the probable error shrunk to less than 1.2 would eliminate whatever there was of statistical significance. If the probable error of M_B were used the result would be more hopeful, but in strict fairness we should use the formula for the probable error of the difference 9.2 of the two means as a function of their indiivdual probable errors; this would give a substantial indication of a significant statistical difference between the means provided, only no allowance for the weight correction be made.

We may raise the question of the comparison of the raw milk on the one hand and of the totality of treated milks on the other. I have not had time to compute the probable errors. The results for the means are:

			Reduced
Raw	M = 30.65 days	Avg. Wt. = 299	Raw
Bot. Past.	M = 21.4 "	" " = 264	26
Boiled	M = 18.7 "	" " = 238	22
Vat Past.	M = 18.2 "	" " = 252	23
Autoclaved	M = 17.4 "	" " = 232	22
Air Free	M = 15.5 "	" " = 237	22

The last column contains a rough estimate of the value of the mean for guinea pigs of the given average weights if fed raw milk. It is my judgment, though I can give no numerical estimate of the probability of that judgment, that the following conclusions are reasonably safe:

(1) On treated milk the pigs do develop scurvy sooner than on raw milk even when allowance for weight is made.

(2) The difference in the time required is smaller than I should have expected.

(3) There is no indication that the different ways of treating the milk produce statistically different results.

(4) An experiment simultaneously performed with sets of 25 pigs of like age, weight and sex and as homogeneous genetically as possible would probably give a good deal of significant statistical data. (The size of the litters from which the pigs were taken might have to be kept constant.)

In bringing this paper to a close I must plead the brevity of my time for preparation as an excuse for so inadequate a treatment of the large amount of data submitted to me and of similar data found in the literature on feeding experiments. Statistical work carefully done takes time—not merely time for routine calculations but far more time for thought. I am glad to know that statistical studies are arresting the attention of biochemists. The physicists and engineers of the Western Electric Company have found that they must resort to such methods when dealing with measurements of such inherently variable phenomena as the microphonic properties of carbon as used in telephone transmitters where the utmost care does not suffice to control the properties to the extent ordinarily attainable in physics. And as the use of the statistical method spreads, we must and shall appreciate the fact that it, like other methods, is not a substitute for but a humble aid to the formation of a scientific judgment. Only with this philosophy in mind may we truly hope, with care, to avoid, in the main, being classed in the superlative category of that oft-cited sequence of liars, damned liars and statisticians!

EDWIN BIDWELL WILSON
HARVARD SCHOOL OF PUBLIC HEALTH

THE SELECTION OF SUBJECTS FOR RESEARCH

THE question whether students should select subjects for research entirely of their own choice, or from a list of subjects proposed by their chosen professor, has been raised in many places and by numerous student generations, but I do not recall seeing any discussion of the subject. Wherever any considerable amount of research work is being done, it is important that the general policy be thoroughly understood in order that the *esprit de corps* may be maintained at the highest possible level.

Let us admit at the outset that almost any subject that one can suggest is worthy of investigation and that, *other things being equal*, the more lines that are being followed in a given laboratory the better. Diversity of interest has a broadening influence.

The trouble is that other things are never equal. No institution, no matter how large or how richly endowed, can possibly be equipped to do research work of an intensive character in more than a very few fields in which students may profess an interest. It is not too much to say that any institution which attempted to offer research facilities to meet the supposed needs of every student would descend to superficiality. It would receive for its pains the contempt of its graduates and the neglect of the public.

On the other hand, no institution is so small or poor that it can not do something to increase the sum of human knowledge, provided that it adheres unswervingly to a sufficiently narrow program, mapped out perhaps many years in advance of its possible realization. Such a program furnishes its own justification. Only one criterion must be met. Does the

proposed program deal with fundamental problems or are the problems of only ephemeral interest? If the results will not be worth publication, the work is not worth attempting. If, on the other hand, the work *is* so very important to some particular industry that its results can not be published, the work should be done outside of the university laboratory.

As a matter of fact, training in research in our colleges and universities is really training in the methods of research and practically never in the particular research work which the student may care to follow later. The student takes up a problem suggested by his professor and according to the ethics of the matter which have gradually evolved, the student does not feel at liberty to continue the investigation of the same subject without the approval of the professor who first suggested the problem. The reason for this is obvious. Of the large number of students who have toiled so unceasingly in the Harvard laboratory in measuring the atomic weights with an accuracy heretofore unknown, how many have continued to measure atomic weights as part of their life's work? Bear in mind that I am not suggesting that the work going on in the Harvard laboratory is unimportant. It is most important and it had given that laboratory an international reputation, even before its unexpected fruition in the discovery of the *isotopes.* I do not even suggest that atomic weight work is not excellent training for chemists of the proper caliber.

The point which I wish to make is that the particular problem is of little moment to the student. He is learning research methods and they are not so very different, whether in chemistry, physics, biology or history. The work is monotonous and often discouraging. There is much chaff for every kernel of grain. To the student I would say, "Here is the test of tests for your absolute integrity, your tenacity of purpose, your ability to stand in the No-Man's Land of knowledge and profess a love for truth where there seems to be no truth. Here is

> Machinery just meant
> To give thy soul its bent,
> Try thee and turn thee forth, sufficiently impressed."

Students are going to the Cavendish Laboratory in Cambridge, England, because Rutherford is working on radioactivity there; others are going to Cambridge, Massachusets, because Richards and Baxter are measuring atomic weights and volumes. Narrow fields for great laboratories, you say? Careful, you may not know how vast those little atoms are or how great their powers as shown by radioactivity. Today is narrow only because it is here and now. Lift your eyes and to-day becomes a part of all time as broad as your mind can conceive. The narrow problem is like the

> Flower in the crannied wall,
> I pluck you out of the crannies,
> I hold you here, root and all, in my hand,
> Little flower—but if I could understand
> What you are, root and all, and all in all,
> I should know what God and man is.

Our tiny problem quickly branches out into more fields than any one mind can compass, and there must then come the process of delimitation.

If I may be pardoned a personal reference, I have tried to limit my own researches to the field of a certain kind of flow of matter. I say a "certain kind," because the subject is so large that I have had to exclude the ordinary flow which we have in rivers and pipes, yet the problems lead one through chemistry, physics, engineering, mathematics, biology, geology, not to mention excursions into the modern and ancient languages and the fascinating subject of philology. How is a student to be expected to have any interest in, let us say, plasticity, about which one knows scarcely anything as yet. But, if "everything flows," as Heraclitus maintained, who can say that it may not prove to be worth while to measure the plasticity of the rocks and metals as well as of rubber and paint? If it should turn out that the new knowledge was worth while, there would be a demand for men who possessed it, and students would be drawn towards this particular branch of knowledge. As a corollary, it is supposed that industries will seek elsewhere men with other types of specialized knowledge, and students desiring those types of knowledge will seek them elsewhere. There is thus a very desirable specialization going on in the universities of the world.

After all, the important thing is to be engaged on some problem. As Carlyle has said:

> Produce! Produce! Were it but the pitifullest infinitesimal fraction of a product, produce it in God's name! 'Tis the utmost thou hast in thee: out with it, then.

And whether we ourselves can produce or not, it little behooves us to harshly criticize the meager results of those who struggle on in the quest. Arthur Gordon Webster was a world authority on sound, the inspiration of his colleagues in physics for a generation, the life of the meetings of the American Physical Society, of which he was a founder. He imagined that his colleagues were no longer giving him their praise and encouragement, and he stopped his researches forever with a revolver shot. For lack of encouragement, others have stopped their researches at all periods of life or before really beginning them —not so dramatically as poor Webster, but quite as effectively. America needs to turn out a far greater volume of scientific research, and the only thing that is lacking is adequate popular support. In the selec-

tion of subjects for research we may safely follow the successful European practice, since only in this way may the morale be maintained.

Eugene C. Bingham

Lafayette College

SCIENTIFIC EVENTS

THE BRITISH JOURNAL OF EXPERIMENTAL BIOLOGY

Hitherto there has existed in Great Britain no journal which served specifically for the publication of researches in experimental biology lying outside the confines of genetics on the one hand, and traditional human physiology on the other. American workers who have created a powerful impetus to experimental inquiry in biological science will, it is hoped, welcome the announcement that a *British Journal of Experimental Biology* will appear in September, 1923, issued by Messrs. Oliver and Boyd, from the Animal Breeding Research Department at Edinburgh. While a primary object of the journal will be to promote in Great Britain the extension of inquiry along experimental lines, it is the earnest hope of the editorial board that American and continental scientists will give their support not only by subscribing but also by offering contributions for publication. All communications should be addressed to the Managing Editor, the Animal Breeding Research Department, the University, Edinburgh, Scotland.

F. A. E. Crew,
W. J. Dakin,
J. Heslop Harrison,
Lancelot T. Hogben,
Julian S. Huxley,
J. Johnston,
F. H. A. Marshall,
Guy C. Robson,
A. M. Carr Saunders,
J. MacLean Thompson.

FELLOWSHIPS IN MEDICINE[1]

"The Rockefeller Foundation, New York, has entrusted the Medical Research Council with a fund to be used in providing fellowships in medicine in the United States. Fellowships will be awarded by the council, in accordance with the desire of the foundation, to graduates who have had some training in research work in the primary sciences of medicine or in clinical medicine or surgery and are likely to profit by a period of work at a university or other chosen center in the United States before taking up positions for higher teaching or research in the United Kingdom. A fellowship will be of the value of not less than £315 a year for a single fellow, or £470 for a married fellow, payable monthly in advance. Traveling expenses and some other allowances will be made in addition. A fellowship will be tenable for one year, which will as a rule begin in September. Applications for fellowships tenable for the academic years 1923–24 should be made not later than July 20th next. Full particulars and forms of application are obtainable from the Secretary, Medical Research Council, 15, York Buildings, Adelphi, London, W.C.2. It is understood that similar medical fellowships provided by the Rockefeller Foundation will be awarded by the National Research Council at Washington to American graduates desiring to work for a time at selected centers of research work in this country. Both announcements are of great interest. It is of course a commonplace to say that science is international and knows no boundaries; but the practical application of the principle frequently encounters difficulties, to the detriment of progress. Some of these difficulties are removed when scientific workers know those of other countries and their methods of work. The United States now possesses many first-rate laboratories and research institutes, and it will be a great advantage to the British fellows to work in them."

[1] From the *British Medical Journal*.

THE INFLUENCE OF MODERN SCIENCE ON HISTORY AND CIVILIZATION

Dr. Edwin E. Slosson, director of "Science Service," Washington, D. C., delivered a series of five lectures before teachers attending the summer session in the University of Pittsburgh. Schedule of these lectures follows:

July 16, "Gasoline";
July 17, "Refrigeration";
July 18, "Photography";
July 19, "Sugar";
July 20, "Coal-tar Products."

These lectures clearly illustrated the possibility of bringing to the layman a realization of his debt to science. Not only did Dr. Slosson show how we were indebted for conveniences, but he intimated how gasoline and other modern fuels had a tendency to spread civilization toward the poles, while the application of the principles of refrigeration made it possible to advance into tropical climates. In his talk on coal-tar products, he referred to Bayer 205, which Germany offered for her lost African colonies. He told how the discovery of a single chemical product might render it a medium of exchange in international relations.

In the talk on photography, applications of the four dimensions and Einstein's principle of relativity in our every-day motion picture were cited.

Dr. Slosson is to be commended for the compelling evidence which he has gathered to show that science is

not only a matter of interest in the laboratory and the factory, but that it is of vital importance to men in every-day life.

A. Silverman

EXPLORATIONS FOR RUBBER

The *Journal of Industrial and Engineering Chemistry* gives the following particulars in regard to expeditions now investigating possible sources of rubber supply:

W. L. Schurz, United States commercial attaché to Brazil, is in charge of the field expedition that is to investigate the Amazon rubber region in behalf of the Department of Commerce. He will be assisted in this work by O. D. Hargis, rubber plantation expert, and C. F. Marbut, of the Bureau of Soils, Department of Agriculture, who will make a study of the soils of this region in reference to rubber production. This party will cooperate with four experts from the Bureau of Plant Industry—Carl D. La Rue, James R. Weir, E. L. Prizer and M. K. Jessup—whom the Department of Agriculture has sent to Brazil to make a biological study of rubber plants in the Amazon Valley. They sailed from New York direct for Para about the middle of July and will probably be gone about eight months.

D. M. Figart, a special agent of the Department of Commerce who is well known in Far Eastern circles, sailed from the United States last month on his way to southern India, Ceylon, British Malaya and the Dutch East Indies, where he will make a comprehensive study of all phases of the rubber industry.

Two other parties, one for northern South America, Central America and Mexico, and one for the Philippines, are being planned.

Several months ago Harry N. Whitford, professor of tropical forestry, Yale University, was appointed by the Department of Commerce and placed in charge of the investigation of sources of crude rubber and the possibilities of developing rubber plantations in the Philippine Islands and in Latin America. J. J. Blandin, formerly in charge of rubber plantations of the Goodyear Tire and Rubber Company, was designated as his assistant.

SCIENTIFIC WORK IN SIBERIA

Professor T. D. A. Cockerell, of the University of Colorado, in a letter from Vladivostok, Siberia, says:

We arrived here safely on July 3 and had no difficulty whatever with the authorities. We had, however, been detained a week in Tsuruga, Japan, because the Osaka Shosew Kaisha would not take us on their ship, fearing trouble with the Russians at this end. Next Tuesday we hope to start for the Amagu River (about 400 miles up the coast), to examine the deposit that contains fossil insects. We go in a small trading steamer. Last night we were entertained at dinner by a company of scientific people of Vladivostok, and speeches were made by Mr. N. Solovieff, director of the museum, and Mr. Davidoff, director of the Hydrographical Institute, both expressing the most cordial attitude toward American scientific men, and the desire for better understanding and more cooperation. We find a very considerable amount of important scientific work going on here. Thus the geographical committee, under Dr. Kryshtofovich, has issued a series of very interesting contributions to geology and paleontology; Dr. Paul de Wittenbourg, with whom we have become well acquainted, has published extensively on local geology; Dr. Arnold Moltrecht, an exceedingly keen naturalist of wide experience, has done a great deal of work on the Lepidoptera; the Hydrographical Survey is actively preparing and publishing review maps of the coast, the old maps being in some cases at least 20 miles wrong, resulting in shipwrecks. They are also collecting quantities of marine animals. Mr. Vladimirsky of the observatory is keeping the most accurate records, using in some cases new instruments which he has designed or invented, and had made in Vladivostok. The Commercial School, under Mr. Lutrenko, is a large and excellently equipped institution, with departments of biology, chemistry, physics, etc. Mrs. J. K. Shishkin is a botanist who has worked on the flora of the region, and has prepared a good herbarium, the condition of the plants being exceptionally fine. Altogether, we find much scientific activity, in spite of many unfavorable conditions, and every promise of important developments in a country extraordinarily rich as a field for research. All the men desire cooperation with the scientific men of America and are extremely anxious to obtain our more recent publications, especially those of a general character, monographs, and works on the natural history of the Northern Pacific countries. We expect to sail from Yokohama for Vancouver about September 1, but it all depends on when we can get back from the Amagu River.

APPOINTMENTS IN AGRICULTURE AT THE UNIVERSITY OF CALIFORNIA

Tracy I. Storer, field naturalist of the California Museum of Vertebrate Zoology, University of California, has been appointed assistant professor of zoology at the Branch of the College of Agriculture at Davis.

William Adams Lippincott, professor of poultry husbandry in the Kansas State Agriculture College, has been appointed professor of poultry husbandry in the university and head of the department of poultry husbandry at the Branch of the College of Agriculture at Davis.

William Henry Chandler, professor of pomology and vice-director of research of the New York State College of Agriculture, Cornell University, has been appointed professor of pomology in the University of

California to have charge of the work in pomology at Berkeley.

With the appointment of Harry S. Smith, chief of the Bureau of Pest Control, Sacramento, as associate professor of entomology in the University of California, the work in the biological control of insect pests formerly conducted by the State Department of Agriculture has been transferred to the University of California. Mr. Smith assumed his duties in connection with the university on July 1, and is stationed at the Citrus Experiment Station, Riverside. H. M. Armitage, entomologist, and A. J. Basinger and Harold Compere, assistant entomologists, will be stationed at the Whittier Laboratory which is to be retained for this work. The regulatory and police functions of the Bureau of Pest Control will be retained by the State Department of Agriculture. The university will continue to maintain one or more explorers in foreign countries in the search for promising beneficial insects. Mr. E. W. Rust, the present parasite collector, will be stationed in South Africa during the coming year.

SCIENTIFIC NOTES AND NEWS

Dr. T. G. Bonney, the distinguished English geologist, celebrated his ninetieth birthday on July 27.

In connection with the recent international conference of chemists in Cambridge the doctorate of science was conferred upon Dr. Wilder D. Bancroft, professor of physical chemistry at Cornell University.

In addition to the election of Professor Charles F. Chandler to honorary membership in the Society of Chemical Industry, announced last week in Science, Prince Ginori Conti, president of the Italian Chemical Society; M. Paul Kestner, president of the French Society of Chemical Industry; Professor Joji Sakurai, Japan, and Sir Dorabji J. Tata, India, have been elected honorary members.

M. Jean Perrin, professor of physical chemistry at the Sorbonne, has been elected a member of the Paris Academy of Sciences, in place of M. Bonty. M. René Maire has been elected correspondent in botany to succeed the late M. Battandier, and Sir Robert Hadfield, of Sheffield, correspondent in chemistry in the place of M. Paterno, who has become associate member.

It is announced in *Nature* that the Royal Danish Academy at its last annual meeting elected the following honorary foreign members: Professor Albert v. Le Coq, of Berlin, Professors Charlier, J. Forssman and C. M. First, of Lund, Dr. F. A. Bather, of the British Museum, and Professor F. O. Bower, of Glasgow.

The staff of the laboratory of the Henry Phipps Institute of the University of Pennsylvania recently gave a farewell dinner in honor of Dr. Paul A. Lewis, for thirteen years director of the laboratory. Dr. Lewis has accepted a position at the Rockefeller Institute, Princeton, N. J.

The title of emeritus professor has been conferred by the University of London on Dr. W. D. Halliburton, on his retirement from the chair of physiology at King's College, which he has held since 1890.

Professor Andrew Gray is retiring from the chair of natural philosophy of the University of Glasgow in which he succeeded Lord Kelvin in 1899.

Professor Christian Eijkman, of Utrecht, is retiring from his chair and the charge of the Hygiene Institute, having reached the age limit. His pioneer work on beriberi and other deficiency diseases was done in the Dutch East Indies, but he continued to work after returning to the Netherlands in 1898.

Dr. Ernst Beckmann, formerly professor of applied chemistry at Leipzig and until recently director of the Institute for Chemistry at Dahlem, celebrated his seventieth birthday on July 4.

The Triennial Congress of the International Surgical Society, under the presidency of Sir William Macewen, was formally opened on July 17 by the Prince of Wales at the Royal Society of Medicine, London, before a large gathering of delegates, representing about sixteen nations. Lord Curzon of Kedleston, secretary for foreign affairs, and Mr. Neville Chamberlain, minister of health, welcomed the delegates on behalf of the government. In his address of welcome the Prince of Wales said: "I am also glad to extend that welcome to your last president, Professor Keen, of Philadelphia, who, in spite of the eighty-six years he carries so lightly, and the weight of a world-wide reputation, is again amongst us ready, as always, to take part in every meeting—social as well as scientific—of this distinguished gathering."

A portrait of President James Rowland Angell, of Yale University, formerly professor of psychology and dean of the faculties at the University of Chicago, has recently been completed by Ralph Clarkson, of Chicago, who has painted portraits of a number of other members of the faculties, including Professor Albert A. Michelson, head of the department of physics; Professor Thomas C. Chamberlin, formerly head of the department of geology, and Professor Rollin D. Salisbury, late dean of the Ogden Graduate School of Science. A portrait of Professor John Merle Coulter, for twenty-seven years head of the department of

botany, has been painted by a well-known artist from Vienna, and will be presented to the university by colleagues and former students of Professor Coulter.

SIR JOHN BLAND SUTTON has been elected president and Sir Berkeley Moynihan and Mr. H. J. Waring have been elected vice-presidents of the Royal College of Surgeons of England.

AT the annual meeting of the Manchester Literary and Philosophical Society, Professor H. B. Dixon was elected president; the vice-presidents are Mr. T. A. Coward, Professor A. Lapworth, Mr. C. E. Stromeyer and Professor F. E. Weiss.

AT the annual general meeting of the Röntgen Society, London, the following officers were elected: *President,* Sir Oliver J. Lodge; *vice-presidents,* Sir Ernest Rutherford, Dr. A. E. Barclay and Dr. F. W. Aston.

SIR FRANK DYSON has been appointed to represent the International Astronomical Union on the International Research Council. Norway, Spain, Switzerland and Portugal have now joined the union.

MR. E. G. BOULENGER, at present curator of reptiles at the Zoological Gardens, London, has been appointed director of the new aquarium. Miss Joan B. Procter has been appointed curator of reptiles.

DR. WALLACE CRAIG, formerly professor of philosophy in the University of Maine, has been appointed librarian in the department of biophysics of the Cancer Commission of Harvard University.

MR. IVAR N. HULTMAN has recently been made chemist in charge of operations at the Kingsport plant of the Tennessee Eastman Corporation. At the close of the war Mr. Hultman became associated with the synthetic organic chemistry department of the Eastman Kodak Company, at Rochester, N. Y. About two years ago he was transferred as chemist at the Passaic plant of the Eastman Chemical Corporation, which position he has held until the present time.

THE following have recently joined the research laboratory staff of the Eastman Kodak Company: Robert F. Mehl, who finished his graduate work at Princeton this year; Paul A. Anderson, who finished his graduate work at Harvard this year; Dr. Merle Dundon, National Research Council Fellow at Ohio State during the past year; Arthur B. Corey, instructor in chemistry, University of Vermont, during the past two years; J. L. Miles, Dartmouth, 1923; E. H. Grupe, Union, 1923; George W. Chapin, Allegheny; Harold C. Folts, Syracuse, 1923, and E. M. Lowry, instructor in physics, Syracuse University, during the last two years.

THE annual representative meeting of the British Medical Association opened at Portsmouth on July 20 under the chairmanship of Dr. R. Wallace Henry, of Leicester, clerk of the representative body. Mr. J. Basil Hall, M.A., F.R.C.S.E., was elected president of the association for 1924–25, and it was decided that the annual meetings in 1925 should be held in Bath. Sir Daniel Drummond, president of the association in 1921–22, was chosen a vice-president in recognition of his past services, and the following were elected overseas vice-presidents of the association: Mr. George Adlington Syme (Melbourne), Dr. Robert Henry Todd (Sydney), Dr. Harry Edward Gibb (Wellington, New Zealand), Dr. Wilfred Watkins Pitchford (Johannesburg), Dr. Dugald Campbell Watt (Pietermaritzburg). Dr. S. Morton MacKenzie (Dorking), chairman of the organization committee, in presenting that body's report, said that the association now had 25,454 members. Two thousand new members had joined since the beginning of the year. Allowing for losses from death and other causes there had been a gain of 1,172 in the membership since January last. Of their members 607 had belonged to the association for more than forty years.

THE 104th annual meeting of the Swiss Society for Natural Sciences will be held from August 30 to September 2 at Zermatt. This will be the fifth occasion when the society has met in the Canton of Valais. The work of the meeting will be divided into fifteen sections as follows: (1) Mathematics, (2) physics, (3) geophysics, meteorology and astronomy, (4) chemistry, (5) geology, mineralogy and petrography, (6) botany, (7) zoology, (8) entomology, (9) paleontology, (10) anthropology and ethnology, (11) medical sciences, (12) history of medicine and the natural sciences, (13) veterinary medicine, (14) pharmacy, and (15) engineering science. In addition to the sectional gatherings, there will be general discussions which will be addressed by distinguished men of science. Among the topics thus dealt with will be: Phylloxera in Valais, by Dr. H. Faës, director of the Federal Viticultural Station, Lausanne; earthquakes in Switzerland, by Dr. A. de Quervain, of the University of Zurich; and the geology of the neighborhood of Zermatt, by Professor E. Argand, professor of geology, paleontology and petrography in the University of Neuchâtel. The following officers have been appointed for the meeting: *President,* Rev. C. M. Besse; *vice-president,* Dr. J. Amann; *treasurer,* M. E. de Riedmatten, and *secretary,* M. A. de Werra, of Sion, Valais.

THE agricultural and food division of the American Chemical Society combines with the fertilizer division at the Milwaukee meeting of the society in September to hold a symposium on fertilizers, soils and crops.

In the past few years there has seemed to be a need for what may be termed the problem viewpoint of research in soil problems. The different divisions of work are so woven together that it takes a meeting bringing together men from the different branches of science, pure and applied, to adequately discuss the problems involved. We are requested to state that those who can present papers on subjects that should come before this meeting as well as those who have subjects or speakers to suggest should communicate with H. A. Noyes, chairman of the agricultural and food division of the American Chemical Society, in care of the New Rochelle Research Laboratories, New Rochelle, New York.

THE one hundred and twenty-eighth meeting of the American Institute of Mining and Metallurgical Engineers, it is announced, will be held on August 20 to 31 in Ontario and Quebec. With the cooperation of the Minister of Mines of these two provinces and of the members of the Canadian and American Institutes of Mining and Metallurgical Engineers, the vast mineral wealth of Canada will be placed on exhibition. Petroleum and gas will be among the principal general subjects of the technical sessions, which are to be held in Montreal. The geology of Santa Elena oil fields, Ecuador, will be discussed by Joseph H. Sinclair, of New York, and Professor Charles P. Berkey, of Columbia University. Other papers will be presented by A. F. Meston, of New York, and Oliver U. Bradley, of Muskogee, Okla.

EARL G. STURDEVANT, who has served as professor of physical chemistry at Western University, London, Canada, since 1920, resigned this position on June 1 to accept a position with the Western Electric Co. as development engineer. Dr. Sturdevant is working on the manufacture of insulated wire.

JOHN H. SCHMIDT has resigned his instructorship in organic chemistry at the University of Wisconsin to accept a position as research chemist with the Redmanol Chemical Products Co., Chicago, Ill.

W. C. GANGLOFF, formerly research chemist with the National Aniline and Chemical Co., is now chief chemist with Dextro Products, Inc., Buffalo, N. Y.

THE public health service of Spain has appointed the following three physicians to the fellowships offered by the Rockefeller Foundation for a visit of inspection and study in America: Drs. Fernández Besones, inspector for Salamanca province; Ortiz de Landazuri, of the central sanitary brigade, and Fuegó, the bacteriologist of the public health headquarters at Vigo.

DR. C. E. KENNETH MEES, director of the research laboratory of the Eastman Kodak Company, sailed for England on July 6 for an extended business trip. Dr. S. E. Sheppard has been made acting director of the laboratory.

PROFESSOR RALPH G. WRIGHT, head of the department of chemistry of Rutgers College and the State University of New Jersey, has been granted a year's leave of absence. Ernest Little, acting professor of chemistry at the university, will be the acting head of the chemistry department during Dr. Wright's absence.

LEAVE of absence has been granted to Professor Cossar Ewart, Regius professor of natural history in the University of Edinburgh, to enable him to accept the invitation of the government of Australia to attend the Pan-Pacific Science Congress in Australia. His recent researches into the origin of the merino sheep and on the evolution of wool have been of great practical value, and he has been specially invited to contribute to the proceedings of the congress.

UNIVERSITY AND EDUCATIONAL NOTES

THE student body, alumni and friends have decided to establish a research endowment foundation at the Detroit College of Medicine and Surgery. It is hoped to raise at least $100,000 to make the foundation permanent. It is announced that a scholarship in pathology, valued at about $18,000, has been raised during the past year, and that the alumni association is now engaged in raising a European scholarship of $20,000, which will enable the college to send at least one student to Vienna, Glasgow or Edinburgh each year.

FOLLOWING on the death of his widow, the estate of the late Professor Campbell Brown has been handed over to the University of Liverpool under the conditions stated in his will. These provide that: (1) A Campbell Brown chair of industrial chemistry shall be established, the first professor to specialize in oils, fats and waxes. In the first instance the salary shall be £1,000 per annum. (2) The income of a sum of £5,000 shall be placed at the disposal of the professor for the upkeep of his department. (3) A Campbell Brown fellowship, value £150 per annum, and (4) The balance to be used for scholarships.

WITH a view to improving the health conditions of the Japanese people, Baron Masuda and Baron Mitsui have each contributed 200,000 yen to the Keio University to establish a food research laboratory in connection with the university hospital. This food laboratory will be the first of its kind in Japan. Dr. Kenta Omori, the head of the research work, and Dr. Z. Kawakami will soon be sent by the Keio University authorities to America and then to Europe for the

purpose of studying similar undertakings in those countries.

PROMOTIONS to associate professorships in the faculties of the University of Chicago are announced as follows: Georges Van Biesbroeck and Storrs B. Barrett, in astronomy; Edward S. Robinson and Forrest A. Kingsbury, in psychology; Arthur J. Dempster, in physics; Warder C. Allee, in zoology; Esmond R. Long, in pathology; Emery T. Filbey and Guy T. Buswell, in the College of Education.

MR. G. C. STEWARD, fellow of Gonville and Caius College, has been appointed fellow and lecturer in mathematics at Emmanuel College, Cambridge.

DISCUSSION AND CORRESPONDENCE

PROPOSALS FOR THE PRESERVATION OF THE WISENT

IT seems to be unfortunately only too true, occasional contrary reports notwithstanding, that the European bison or wisent (Bos bonasus L., Bison europaeus Ow.) of which prior to the great war about 700 lived in the Lithuanian forest of Bjeloviesh, near Grodno, has been exterminated there. The fate of the wisents that lived in northwestern Caucasia is unknown, but in all probability this herd no longer exists and of the herd formerly living in the estates of Prince Pless, Upper Silesia, only three remain. Thus, when summed up, no herd exists any longer, only some fifty head, which are scattered widely in zoological gardens or preserves.

Dr. Kurt Priemel, director of the Municipal Zoological Garden in Frankfurt and an expert on the matter, suggests that by a systematic cooperation of all persons interested the wisent may be permanently saved or at least preserved for many a year to come. Dr. Priemel proposes that the methods so successfully pursued by the American Bison Society be applied to preserve the wisent. To do this, however, the cooperation of all interests, German and foreign, is indispensable; only thus can systematic breeding be carried out, the necessary funds raised and general interest for the plan gained. It is proposed, therefore, to found a Society for the Preservation of the Wisent. Statistical data have been made up and a card catalogue arranged in which information regarding all the known living wisents has been compiled. The most important problem for the new society, when formed, will be to endeavor to increase the number of animals by systematic breeding, an interchange of individuals from various sources being also considered. As it is, with one exception, all the available stock derive from the Bjeloviesh herd. This exception is a bull of the Caucasus breed, which has always played an important part in reproducing the race and will continue to do so, as long as possible. The animal was presented to Karl Hagenbeck in 1907 by the Czar.

Should systematic breeding produce satisfactory results, and successful experience of many zoological gardens tend to encourage this hope, in twelve to fifteen years small herds of wisents may be turned loose in extensive preserves. These preserves should offer, as far as possible, variegated topography, climate and forest formations. A beginning has been made by Count Arnim-Boitzenburg, of Boitzenburg-Uckermark, province of Brandenburg, who has introduced the wisent herd formerly owned by Hagenbeck upon his estates. It is to be hoped that the dangers of inbreeding may be obviated and a healthy development assured.

THEODOR G. AHRENS, PH.D.

STAATLICHE STELLE FÜR NATURDENKMALPFLEGE,
BERLIN-SCHÖNEBERG

THE AMERICAN EDUCATOR AND SCIENTIST

THE title-page of the recently issued "The American Educator and Scientist, a Vocational Blue Book," bears the slogan: "Representation a Criterion of Distinction." After glancing through the text one is tempted to wonder what is the criterion of representation. Among the many who are not "represented" are the president of Harvard University and the president of the National Academy of Sciences.

Nothing is specified regarding the life work of James Furman Kemp except that he is manager of the New York Botanical Garden. Charles Whitman Cross is given all the credit for authorship of Quantatative Classification of *Ingenious* Rocks, although in the next entry but one Whitman Cross is described as author of Quantitative Classification of *Ingenious* Rocks.

This work is one of twelve blue books issued annually by the same publishers. The series includes The American Elite and Sociologist. The price of each volume is $10.

OMISSUS

WASHINGTON, D. C.

SCIENTIFIC BOOKS

Grundzüge der Paläontologie, II Abt., Vertebrata. By K. A. VON ZITTEL. Neuarbeitet von F. Broili und Max Schlosser. R. Oldenbourg, München u. Berlin. 4e Auflage, 1923.

THE new edition of this classic text-book will be a great boon to all workers and teachers in vertebrate paleontology. There are unfortunately no compre-

hensive and up-to-date text-books in English on this subject, or at least none of this type. Lull's "Organic Evolution" is admirable of its kind; it is didactic, aiming to set forth and expound principles and to illustrate them by selected examples from the fossil record. Osborn's and Scott's well-known books cover their selected fields excellently and authoritatively, and various other recent English and American books are indispensable. Zittel's text-book, however, is of a different kind. It is rather a dictionary than a text-book in the usual sense. It is a systematic account of the fossil vertebrata known to science, with a concise summary of how much is known of each genus, its diagnosis, relationships and occurrence of the known species. Brief outlines of the essential distinctions of the larger groups, with very complete and well-selected lists of references for each group, a few final pages reviewing the record as a whole and an index of names bring the volume up to a little over 700 pages of large octavo. Save in the matter of taxonomy and with exception of casual comments here and there on phylogenetic relationships, the book avoids any statement of theories and principles and confines itself entirely to facts of record. It does not explain evolution or defend it; it does not discuss the causes of extinction or the reasons for the dominance of reptiles in the Mesozoic, or any of the thousand and one problems that the study of the record suggests to an inquiring mind. But it does give the facts, completely and accurately and conveniently, and whether you desire to identify a specimen or to look up an unfamiliar genus, to find out what is known of the geologic history of some group or to get an exact knowledge of the fossil evidence illustrating some principle or bearing on some problem to be set forth, you refer with confidence to your Zittel. The essentials of the known record will be there and the bibliography will enable you to run down details so far as available.

There are several other excellent German text-books in this subject, notably those of Abel and Strömer, but none of them quite on the Zittel plan. The school of paleontology which Zittel built up at Munich was preeminently a school of facts, of exact practical knowledge of the science, based on the study and comparison of the great collection of fossils brought together under his direction, and since his death in 1904 the same policy has been consistently and ably pursued under direction of Doctor Broili and his colleagues. The results are reflected in the magnificent collections of fossil vertebrates and invertebrates in the Munich Museum of Paleontology, selected and arranged for purposes of study and research, and in the revised editions of the Grundzüge issued in 1911, 1918 and 1923. The original edition was translated into English by the late Dr. C. R. Eastman in 1902; no translation of the revised editions has been published, chiefly because it has been difficult for American specialists to accept the taxonomic arrangements unchanged or to agree upon modifications to be adopted.

The present edition has been brought up to date by the inclusion of nearly all the new discoveries down to 1922; a few omissions here and there are mostly unimportant. Various changes have been made in the arrangement and in the descriptive text of the 1911 and 1918 editions; the chapter on dinosaurs has been extended and partly rewritten to conform to recent researches and discoveries; and many additions and minor changes appear throughout the volume. American researches and discoveries are well presented—as indeed they are in most of the German text-books on fossil vertebrates. Many new illustrations have been added; as in preceding editions, the illustrations are always of specimens, few diagrams and no restorations. The only exception is a restoration of the head of *Camarasaurus* (after Osborn) placed beside the skull and jaws on which it was based. A certain system is noticeable, especially with the fossil mammals, in the attempt to represent the skull, the dentition and the feet of the better known types, more rarely the complete or reconstructed skeleton, thus bringing out the salient distinctive characters of each group.

While the treatment is, on the whole, both complete and up to date, there are naturally various minor errors and omissions and a few points open to more serious criticism. The retention of *Lysorophus* among the lizards, although admittedly in a provisional way, appears hardly defensible in view of the researches of Williston, Case, Sollas and others, and its attribution to a family "Paterosauridæ," which is not a proper family name, as it is not based upon any described genus, is contrary to the rules of nomenclature. The association of *Diatryma* and *Phororhachos* is hardly tenable in spite of their remarkable convergence, but perhaps it was not intended to be other than provisional. The primary division of the Mammalia into Eplacentalia (Monotremes + Marsupials) and Placentalia, would hardly be approved by any anatomist. *Blastomeryx* is not a *Hypertragulid*, in spite of the fact that its lateral metacarpals are complete, but a true Pecoran, with the characteristic cannon-bone and other distinctive features of the higher ruminants. The omission of the Paleanodonta, primitive Edentates of the North American Eocene (*Paleanodon* and *Metacheiromys*) is probably owing to Doctor Schlosser's doubts as to

their real affinities (which the reviewer does not share). But they should have been placed somewhere, for they are important types, both known from skulls and skeletons, and upon no theory of their affinities is their evidence negligible. No reference is made to the gigantic and peculiar rhinoceroses first discovered by Cooper in Baluchistan, reported by Borissiak from Turkestan, and quite recently found in Mongolia by Andrews and Granger. There are unfortunately a good many misprints, and the quality of the paper is not up to the old pre-war standards.

But with allowance for all defects, which, after all, are very few or of quite minor importance in comparison to the enormous mass of facts stored within its covers, the authors deserve the cordial thanks and appreciation of all who are interested in fossil vertebrates, in their completion of a revision that involves an immense amount of labor and erudition and a comprehension of the essential facts of the discoveries they have summarized that is far from common, to judge from the misstatements and misunderstandings of the average critical review.

W. D. Matthew
American Museum of Natural History

QUOTATIONS

THE ANNUAL EXPOSITION OF CHEMICAL INDUSTRIES

The Ninth Annual Exposition of Chemical Industries is to be held in New York City, Grand Central Palace, September 17 to 22, 1923. The exposition has always been a place where those with inquiring minds could learn much in a short time regarding chemical equipment and the chemical industry. In late years the junior chemical engineers at Yale have assembled under Professor Read to devote the mornings to serious study and the afternoons and evenings to gaining a more intimate acquaintance with chemical equipment on display. The Advisory Committee of the Exposition recommended that a special feature be made of these facilities this year, and an announcement has been issued offering students of chemistry and chemical engineering a course on the fundamentals of chemical engineering and industrial chemical practice. Lectures will be given by men prominent in the various specialties, and a committee of educators has undertaken to make the course as attractive and profitable as possible. Three principal topics are to be the centers about which the work will be done. These are:

1—Plant Equipment in the Chemical Engineering Industries.
- (a) Disintegration—Crushing and Grinding.
- (b) Mechanical Separation—Grading.
- (c) Separation of Solids from Liquids—Thickening, Filtration, Centrifugal Separation.
- (d) Separation with Phase Change—Evaporation, Distillation, Drying.
- (e) Handling of Materials.

2—Materials of Construction—What materials to use, when, where and why.

3—Chemicals in Commerce—The distribution of chemicals.

It is expected that no charge will be made to students. The Exposition management asks instructors to advise how many of their students will care to avail themselves of this opportunity, and further undertakes to assist students in securing living accommodations while in New York. The seriousness of the work is indicated by the announcement that a report or examination on some phases of the course may be required by the committee.

We urge chemists and chemical engineers, whether students in institutions of learning or otherwise, to take advantage of this unusual opportunity. The men most familiar with the equipment and unit processes will be present. Exceptional facilities for examining devices of different designs and makes will be offered. It will be possible to meet those interested in the same field of work and discuss problems with them. Here is an opportunity to gain in one short week information of value, comparable perhaps to the concentration of data commonly found only in hand-books. Do not miss it!—*The Journal of Industrial and Engineering Chemistry.*

SPECIAL ARTICLES

THE PRODUCTION OF "BROWN-SÉQUARD'S EPILEPSY" IN NORMAL NON-OPERATED GUINEA PIGS

Brown-Séquard was the first to report that operative insults to the nervous system, such as lateral hemisection of the cord, section of the dorsal columns, section of one or both sciatic nerves, produced after a certain lapse of time a variety of interesting motor disturbances in the guinea pig. These disturbances were characterized by attacks of complex, coordinated, tonic and clonic contractions of the muscles of the head, neck, trunk and legs. The motor discharges occurred spontaneously or as the result of pressure stimulation of a certain receptive field of the skin which Brown-Séquard called "epileptogenic zone." This area comprehended roughly the side of the face below the eye and extended backwards, including the scapular region. The zone was unilateral after unilateral lesions and was always located on the operated side when the cord was involved; after damage to the brain, however, the "epileptogenic zone" shifted to the opposite side. In addition to the manifestations mentioned Brown-Séquard also described a transient

"blepharospasm," a "bronchorrhoea" and the expulsion of feces, urine and semen during the attack. Brown-Séquard never observed the symptoms in normal guinea pigs, but Graham Brown[1] in his excellent analysis of these motor phenomena mentions briefly some suggestive motor reactions observable in the normal guinea pig; these appear to have been slight and inconstant, however.

The chief symptoms of the complex known as "Brown-Séquard's epilepsy" may be obtained in the normal, non-operated guinea pig provided certain conditions are fulfilled: (1) The animal must be accustomed to his surroundings, including the experimenter; (2) abrupt movements, unaccustomed noises and apparently also odors, sudden vibrations must be avoided; otherwise the typical reactions following tactile or pressure stimuli of the skin are largely or entirely inhibited. The length of time necessary to fulfill conditions varies considerably in different animals, especially when only touch stimuli are employed.

The touch stimuli were applied by means of long bristles mounted on handles; the pressure stimuli by means of long, slender, wooden rods one eighth to three sixteenths inch in diameter; the stimuli were both of short and long duration and were applied frequently.

The sites where symptoms are most easily elicitable are: (1) A small area just posterior to the angle of the jaw and below the ear; and (2) an area just anterior to the pelvis and above the femur when the animal is in a squatting position. Pressure stimuli are most effective, especially in the beginning. Either side of the body may be stimulated effectively.

Some of the reactions obtained after pressure stimuli in the lumbo-pelvic area are as follows: a lateral arching of the body, the nose of the animal approaching the site stimulated, with rotation of the head so that the plane of the lower jaw is turned towards the body. Associated with this arching, the hind leg of the side stimulated is usually flexed suddenly and strongly at hip and knee, the foot is dorsally flexed at the ankle while the toes may be extended and spread far apart, or the toes may be close together and slightly flexed. At the same time the hind leg of the opposite side is usually strongly and forcibly extended, raising the posterior half of the body, or it may be strongly abducted. The hind leg of the side stimulated may execute a series of scratching movements, the toes moving towards the jaw of the same side; at times the toes actually scratch the jaw and then the toes are usually spread apart. At other times the toes merely approach the jaw and then in general are not spread; when this occurs the dorsal lift of the femur is apparently especially marked, and the movement now resembles the thigh wiping reflex of the frog. The scratch reaction may consist of from one to eight and perhaps more, exceedingly rapid flexions and extensions of the thigh, leg and foot. In animals which have been tested for months this pressure stimulus causes the lateral curvature of the body and neck, but often both hind legs are violently extended at the same time, so that the animal is hurled into the air; the animal, however, always righted itself in midair and was never observed to fall on its side or to roll over.

Pressure stimuli just posterior to the angle of the jaw usually cause, in addition to escape movements, a general shaking of the body similar to that executed by a wet dog, with more or less erection of the hair; wiping of the head and face with the front leg of the side stimulated, the head being rotated towards the non-stimulated side, or a more or less marked scratch reaction of the hind leg of the same side may occur. Often the front leg of the side stimulated may execute a series of rapid back and forth shaking movements.

Touch stimuli may give the same motor reactions, but in addition they permit the observation of other responses which are partially masked when pressure stimuli are applied; some of these are chewing motions, slow, audible, grinding movements of the teeth, dorsal or ventral nodding movements of the head, sneezing associated with unilateral or bilateral wiping of the nose, short convulsive contractions of the muscles of the trunk, neck and legs which raise the trunk slightly from the floor, the head being flexed ventrally. Associated with the latter movements one may observe at times a spasmodic retraction of the angles of the mouth accompanied by a wide separation of the jaws and strong closure of the eyelids.

Increased defecation, urination may be readily observed in these animals after repeated pressure or touch stimulation. In two instances several drops of a milky fluid suddenly issued from the nares (a naris?) and fell upon the reflecting mirror of the observation cage where the animal was being tested. The ejaculation of semen was never seen by me.

From this brief description it will be perceived that the so-called "incomplete attack" of Brown-Séquard may readily be obtained under proper conditions in normal guinea pigs. The absence of the "complete attack" is probably attributable to the normal muscular balance of these animals.

The material upon which this study is based consists of about 60 animals, chiefly males; all of them were under close daily observation for months.

JOHN AUER

ST. LOUIS UNIVERSITY
SCHOOL OF MEDICINE

[1] T. Graham Brown, *Quart. Journ. Exp. Physiol.*, 1910, III, 144.

SCIENCE NEWS

ARTIFICIAL FAT FOR DIABETES

Science Service

THE invention of a new form of artificial fat that can be digested by diabetic patients was announced on August 3 by Dr. Max Kahn at a meeting of the medical staff of the Beth Israel Hospital, New York.

At that hospital feeding with the new fat has given relief in thirty cases of acidosis due to diabetes. One man was carried into the hospital for the purpose of having his leg amputated since it was attacked with gangrene. But after the artificial fat had been added to his diet the acidosis was stopped, the sores healed up and four weeks later the man walked out of the hospital on his own two legs.

Dr. Kahn, who has charge of biological chemistry in the College of Physicians and Surgeons of Columbia University and of diseases of metabolism at the Beth Israel Hospital, has been working for a year and a half to make a fat that would not break down into acid products as do natural fats in cases of diabetes. From recent researches in the chemistry of nutrition he came to the conclusion that a fat with an odd number of carbon atoms would serve the purpose. But such a fat could not be found in nature so it had to be made to order.

The investigations to simplify the method of manufacture and the carrying through of the design of the plant apparatus and installation of equipment have been conducted by Professor Ralph H. McKee, professor of chemical engineering, Columbia University, in his private laboratory, and required the services of two assistants for six months. It was through this investigation that the process has been simplified so that instead of material costing $300 or even $100 a pound, it can now be made in a factory and sold for $8 a pound, and probably this cost will decrease still more once production is well under way. A pound will last a patient from a week to three weeks.

A manufacturing plant has been built in Long Island City, and last week 200 pounds of the new product was turned out. It has been named "intarvin," meaning "intermediate fat," because the molecule contains 17 carbon atoms and is therefore intermediate in composition between the ordinary fats carrying 16 and 18 carbon atoms.

Intarvin is a white crumby substance, tasting something like tallow, but is not so soft. It is either eaten straight or mixed with a little tasteless mineral oil or made up into a mayonnaise or shaken up with buttermilk or baked in gluten bread. The diabetic patients find the new fat quite eatable and it satisfies the craving for fat common in the disease.

It is a curious coincidence that within the year 1922 two remedies, insulin and intarvin, have been invented for diabetes, which, though one of the most common and serious of diseases, has hitherto baffled medical skill. Insulin, which was discovered by Dr. F. G. Banting, of Toronto University, is an extract of animal pancreas which when injected into the veins restores temporarily the power to assimilate sugar. Intarvin is a synthetic fat which is assimilable by diabetics in whom natural fats produce an excess of acid. Neither insulin nor intarvin is regarded at present as a permanent cure for diabetes, but both restore temporarily the digestive powers, the former for sugars, the latter for fats, but each increases somewhat the ability to handle the other type of food.

GLUCOKININ AS A SUBSTITUTE FOR INSULIN

Science Service

DISCOVERY of "glucokinin," derived from plants and appearing to have the properties of insulin, is described by J. J. Willaman, associate professor of biochemistry in the University of Minnesota, in a statement made public by the American Chemical Society.

Recent discoveries in this field establish one more profound relationship between plants and animals, says Professor Willaman, who reports successful use of glucokinin on diabetic dogs and rabbits. Clinical tests as yet have not been made on human beings.

Things are changing fast in the diabetic world, continues Professor Willaman. It was just a year ago that a group of scientists at the University of Toronto announced that they had prepared an extract of pancreas which, when injected into dogs, would cause a lowering of the sugar content of the blood.

Since then the extract has been used successfully in the case of human diabetes at several clinics, and has been manufactured commercially. Now the announcement is made that the active principle has been demonstrated in plant tissue, including lettuce, bean leaves and the onion.

Dr. J. B. Collip, formerly one of the Toronto University group who first made insulin, and now at the University of Alberta, conceived the idea that, since injection of "insulin" enables the animal to burn sugar and store up glycogen, those plants and lower animals which contain glycogen might also contain this active principle.

Glycogen is "animal starch," and is abundant in clams, oysters, yeast and mushrooms. He tried clam tissue, and had no trouble whatever in preparing an extract which helped rabbits and dogs to burn sugar. Yeast, however, proved a stumbling block. He tried over twenty different methods before he found one that would produce an active extract. After that he could prepare very active materials at will.

Next he tried green leaves of lettuce and wheat, and then the bulb of an onion. In all cases he demonstrated the presence of a substance which apparently had all the properties of "insulin." He doesn't give it the latter name, however, but prefers to call it "glucokinin."

SCIENCE

VOL. LVIII AUGUST 17, 1923 No. 1494

CONTENTS

SCIENCE: A Weekly Journal devoted to the Advancement of Science, edited by J. McKeen Cattell and published every Friday by

THE SCIENCE PRESS

Lancaster, Pa. Garrison, N. Y.

New York City: Grand Central Terminal.

Annual Subscription, $6.00. Single Copies, 15 Cts.

SCIENCE is the official organ of the American Association for the Advancement of Science. Information regarding membership in the association may be secured from the office of the permanent secretary, in the Smithsonian Institution Building, Washington, D. C.

Entered as second-class matter July 18, 1923, at the Post Office at Lancaster, Pa., under the Act of March 3, 1879.

SPENCER FULLERTON BAIRD—A PIONEER DISSEMINATOR OF SCIENCE NEWS

THE nineteenth century stands out prominently in the history of the world as the one in which the greatest development of science occurred. In the United States a series of great dominant figures has always conspicuously exerted a potent influence for the benefit of humanity on the progress of science.

Even when the century was at its very beginning the splendid figure of the many-sided Franklin was already almost at its zenith. He knew this and he knew that; he talked with this friend and discussed with that friend, and from the gathering of his friends grew the American Philosophical Society, and Philadelphia became the scientific center of the new world.

The scientific mantle of Franklin passed to Robert Hare, a man of wonderful attainments, conspicuously in chemistry, and to him came Benjamin Silliman, who, having absorbed all that he could acquire in Philadelphia, supplemented it with study abroad and then settled in New Haven as professor at Yale College.

Dana and Hubbard, his sons-in-law, Loomis, Olmsted, Shepard and others were his followers and the *American Journal of Science* came into existence as the great event in American science of the second epoch of the century.

Like a meteor in his brilliancy, Samuel Latham Mitchill flashed on the scene in New York, and for a time Columbia College with its splendid and distinguished teachers of science was foremost. Bruce, Hosack and Renwick are familiar names of that period.

When the century reached its high tide, Louis Agassiz with his wonderful personality settled in Cambridge, and Harvard became the Mecca to where, besides his own son Alexander, Hyatt, Lyman, Morse, Putnam, Scudder, Shaler and Verrill came and studied and then spread their knowledge abroad, illuminating wisdom with marvelous skill and adding much to what was known in natural history. The founding of the Museum of Comparative Zoology with its many fortunate students is a noteworthy event of this time.

Almost simultaneously with the progress made in natural science in Cambridge was that made in Washington under Baird, who, as assistant secretary of the Smithsonian Institution, was slowly developing the

National Museum, in which are deposited "all objects of natural history, plants and geological and mineralogical specimens belonging to the United States." Baird was quick to appreciate the wonderful opportunities that were his, for he had the foresightedness to realize that great agencies as those of the Geological Survey and the Bureaus devoted to American ethnology, entomology and fisheries were also great collecting agencies. From them would come the objects that he needed for the National Museum, and so much of his time was devoted to building up these many scientific offices of the government and in training men for their management.

Baird, like Franklin, was a many-sided man, and there have never been wanting those who would tell of the mighty things he did in developing American science; but my task is simply to describe him as the founder of our American News Science Service. "Baird," writes Billings, "for the most part taught only by the pen and by example." Newberry adds that he had correspondents everywhere who were working along his lines in the interest of science.

While others required rest from their arduous labors or sought recreation in amusements or society, Baird found it in intellectual pursuits. The enormous volume of publications that came to the Smithsonian Institution during his long connection with it passed under his inspection, and from this source he gleaned the scientific news of the world.

Miss Lucy Baird, in her charming "Notes" on her distinguished father's career, which are incorporated in William H. Dall's excellent biography of Spencer Fullerton Baird, tells of the origin of his work for periodicals, which is so interesting that I give it in full. She says:

> In 1869, being in the neighborhood of Philadelphia, he went down to Long Branch on a visit to his sisters, who had a cottage there. On the train he found Mr. George W. Childs, who was also on his way to Long Branch. After some little conversation, Mr. Childs asked him to contribute a scientific column, or, to speak more exactly, about half a column, each week to the Philadelphia *Ledger*, giving items of scientific interest. My father, who was modest as to his literary abilities, as in everything else, felt so sure of his inability to write popular paragraphs agreeably that he was inclined at first to decline this offer, although, to a man of limited means, the remuneration proposed by Mr. Childs was a temptation. Mr. Childs, however, begged him to consider the matter and those of his scientific friends, to whom he confided the matter, urged him so strongly that he decided to attempt it.

This seems to have been the beginning of his contributions to current publications, and it soon led to other similar work in which he was most successful.

I shall not attempt in this place to present any record of Baird's other literary productions or express my opinion in regard to his ability as a writer or as an editor. That part of the task has already been most admirably done by G. Brown Goode in Bulletin 20 of the United States National Museum, which forms one of the series of bibliographies of American naturalists and bears the specific title of "Published writings of Spencer Fullerton Baird, 1843–1882."

From that authoritative source, I find that as early as 1871 Baird began to contribute to *Harper's Weekly* and to *Harper's New Monthly Magazine* regularly items on science, concerning which Goode wrote:

> Many of these are original contributions to knowledge never elsewhere published. Others are critical reviews or notes upon the current literature of science. Others are abstracts of papers, with the addition of explanatory or illustrative remarks. Others still are abstracts of papers, for the most part in the words of the authors of the papers or of some other reviewer.

Miss Baird also writes in her "Notes":

> In addition to the work mentioned above (*i.e.*, in connection with publication of the Harpers) he finally entered into a similar arrangement with the New York *Tribune*, to which he furnished a scientific column.

These various abstracts were subsequently collected, more or less revised and then issued annually in book form as "An Annual Record of Science and Industry."[1]

The first of these was published in 1872 and bears on the title page the statement that it was prepared "with the assistance of eminent men of Science." In this volume are no less than 92 items for which Goode gives credit to Baird as being essentially from his pen.

For six years these volumes continued without change and as showing Baird's remarkable industry, when it is remembered that his duties elsewhere were also very arduous, attention is called to the fact that the volume for 1872, according to Goode, contained 193 items written by him, that for 1873, 187 items, that for 1874, 132 items, that for 1875, 106 items and that for 1876, 76 items.

The heavy demand on the time of Baird, due to the declining strength of Henry, followed by his death, and Baird's succession to the secretaryship of the Smithsonian made it more and more impossible to devote as much of his own time as formerly to the preparation of this press information. Accordingly,

[1] I am not unmindful of the fact that from 1849 to 1866 David A. Wells edited an "Annual of Scientific Discovery," but I have never understood that this was more than a year book, for which special articles were prepared at the end of each year summarizing the development of the topics treated during the given period.

there was a change in the methods used in the volumes of the "Record of Science and Industry" for the years 1877 and 1878, which in Baird's own words was as follows:

A modification of the original plan of the "Annual Record" was commenced in the volume for 1877. Previous to that it consisted of two parts—first, a general summary of progress in the various branches of science; and, secondly, a series of abstracts of special papers, credited to the work in which they were published. These abstracts, although prepared by several specialists, were without indication of their authorship. The experience of several years showed that, in attempting to give abstracts of anything like the most important announcements of the year, more space was required than could be spared for the purpose; and it was therefore determined to enlarge the scope of the first division, and make it include a great amount of detail, each summary to be prepared by some eminent specialist, and to be headed by his name.

This plan was continued with the volume for 1878, the preface of which is dated March 1, 1879, but with this volume the series came to an end. These most admirable summaries were continued in the annual reports of the Smithsonian Institution and formed the most important feature of each of these valuable reports until the death of Baird.

Goode's work as a rule was superior and he seldom omitted an essential item in anything that he wrote, but I am sure that were he living, he would gladly permit me to add the word "editor" to the following description that he wrote of Baird:

He was one of those rare men, perhaps more frequently met with in the new world than elsewhere, who give the *impression of being able to succeed in whatever they undertake.* Although he chose to be a naturalist, and of necessity became an administrator, no one who knew him could doubt that he would have been equally eminent as a lawyer, physician, mechanic, historian, business man, soldier or statesman [and editor].

When the publication of the "Annual Record of Science and Industry" ceased with the volume of 1878, it seemed as if the sun had set, but not altogether, for here and there were bright spots in the sky. The *Scientific American,* founded in 1849, was devoted to the exposition of popular science. In 1876 it added its *Supplement* to give to the world a record of the progress in applied knowledge as manifested by the Centennial Exhibition held in that year in Philadelphia. It still lives in a more dignified dress as a well-edited and useful monthly.

Just above the horizon was the *Popular Science Monthly,* then edited by the gifted Edward L. Youmans and devoted to a higher grade of popular science than any of its predecessors. Later came SCIENCE, which has become probably the most important scientific journal ever published in the United States. All these have paved the way for a *Science News Service,* which, ably controlled by E. E. Slosson, again gives to the public statements of the progress and development of science that are as true, honest and reliable as those put forth by Spencer F. Baird.

MARCUS BENJAMIN

SOME PHYSICAL ASPECTS OF A RECENT ANALYSIS OF THE EARTH'S MAGNETIC FIELD[1]

THE difficulties to be met in the formation of any adequate theory of the origin of the earth's magnetism are in part mathematical, in part geometrical, because of the sphericity of the earth-magnet, but they arise chiefly from the physical conditions involved. No matter what theory is proposed somewhere a hypothesis must be introduced implying new properties of matter or physical conditions below and above the earth's surface, regarding which we have at present either no knowledge whatsoever or but the faintest glimpse. The same remarks apply to that other great problem of cosmical physics—the origin of the earth's electricity. It has accordingly been suggested that terrestrial magnetism and atmospheric electricity may reveal to us hitherto unknown properties of matter; for the properties which the rotating earth and the rotating sun may possess, because of their masses, sizes and angular velocities, *may fail of* detection with the experimental conditions possible in the laboratory.

The most complete and exhaustive analysis heretofore made of the earth's magnetic field, as based on the accumulated magnetic data of the Carnegie Institution of Washington and cooperating organizations, has just reached the preliminary stages of completion. We have now facts of sufficient reliability so that in a number of cases it is possible to say definitely that a theory advanced is not correct or at least not complete.

One of the definite disclosures of interest is that about 94 *per cent. of the earth's magnetic field arises* from systems of magnetic and electric forces inside the earth; about 3 per cent., except for possible relativity effects, is apparently to be referred to an electric system in our atmosphere, and the balance, about 3 per cent., to a system equivalent in its effects to electric currents passing perpendicularly through the earth's surface. Furthermore, we now know that the direction of the axis of the magnetic field of the earth, of the atmosphere and of the sun is related in the same way, for all three bodies, to the direction of

[1] Presented at the meeting of the American Philosophical Society, Philadelphia, April 21, 1923.

rotation of the body, and that the magnetic axis for each of the three bodies is inclined to the axis of rotation, namely, at present, 11.5° for the earth, about 14° for the atmosphere, and about 6° for the sun. The strength of the magnetic fields of these three bodies may be expressed approximately by the product of a physical factor, *f*, into the angular rotation, ω, the square of the radius, *r*, and the density, *D*, of the body. If the same formula could be applied to the other planets, Jupiter, for example, would be enveloped by a magnetic field about as strong as that around the sun.

The physical factor, *f*, may imply new physical properties or changes in the usual laws of electrodynamics, which may possibly be found to hold throughout our universe. But we find that the earth's intensity of magnetization has been diminishing during the past 80 years at the average rate per annum of 1/1,500 part; how much longer this startling rate of diminution will continue we, of course, can not say at present. The more interesting question is, What changes inside or outside the earth can produce such remarkable changes? Certainly the period of rotation, dimensions and density of the earth have not changed sufficiently during the past 80 years to account for the magnetic change. Shall we say our universal physical factor, *f*, has changed sufficiently in 80 years to be responsible for the corresponding magnetic change? If so, what does that mean? Are the new physical properties, or the changes in well-known physical laws, implied in *f*, subject to rather rapid changes, and if so, why?

Let us suppose, for example, that in the factor *f* we have embodied some physical relation upon which both the earth's magnetism and its gravitational force depend. Then, on the basis of the average annual loss in the earth's magnetism, during the past 80 years, 1/1,500 part, we can immediately say that magnetism and gravity are not related to each other as the first power of the factor. For otherwise a change of 1/1,500 part in the earth's magnetism would imply a corresponding change of 1/1,500 part in gravity, a change too large to have escaped detection. On the other hand, magnetism and gravity may be so related that a magnetic change of 1/1,500 part would only imply a change of the square of 1/1,500 part, or about one half of a millionth part in gravity, and this is a quantity which may readily escape detection with our present gravity appliances unless observations with requisite accuracy are made continuously for a number of years at certain standard stations, so as to obtain the accumulative effect.

The examples cited may suffice to show what importance investigations relating to the earth's magnetism and electricity may assume in our studies of the properties of matter.

A theory which is at present receiving careful examination starts with the possibility that there may be motion of electricity, for example, relative to the mass or volume elements. The rate of motion may differ by a very small fraction from that of the angular rotation of the earth and the paths of the comparatively slowly moving electric particles may be subject to a deflecting effect during the earth's rotation, just as are winds blowing over its surface. The net result of the earth's deflecting effect on these "currents" may be such as to cause, on the average, a slow westerly movement of this system of currents, which in turn gives rise to an induced or demagnetizing field, superposed on the primary field. If such currents are the cause of the earth's internal magnetic field, then their distribution at any given time appears to be largely dependent upon the distribution of land and water, doubtless chiefly because of the difference in electric conductivity of the two bodies. While the results of such a theory would in general agree with the observed facts, it will have to be subjected to further careful investigation before any definite statement may safely be made.

As a resultant effect of all systems causing the secular variation of the earth's magnetism, the north end of the magnetic axis of the internal system of the earth's magnetic field, during the past 80 years, has been moving slowly towards the west, and apparently at the same time slowly towards the equator. The indications are that if the magnetic axis completely revolves around the axis of rotation, the period would not be a few hundred years, but many thousand years. The secular variation thus results from changes, with lapse of time, both in the direction of magnetization and in the intensity of magnetization.

A suggestive effect, dependent apparently upon the distribution of land and water, has been disclosed, namely, that the average equivalent intensity of magnetization, for corresponding parallels north and south, is generally larger for the land-predominating parallel than for the ocean-predominating parallel.

For the earth's internal uniform magnetic field, the following data apply for 1922: The magnetic moment, *M*, is 8.04×10^{25} C. G. S.;[2] the components of *M*, respectively parallel and perpendicular to the earth's axis of rotation, are $M_p = 7.88 \times 10^{25}$ C. G. S., and $M_e = 1.60 \times 10^{25}$ C. G. S.; $M_p = 4.93\ M_e$. Were the earth's magnetism uniformly distributed throughout the earth, as it probably is not, the average intensity of magnetization would be 0.074 C. G. S. The magnetic axis intersects the North Hemisphere in

[2] The value of the magnetic moment frequently found in text-books, as dependent on Gauss's analysis for 1830, is 8.55×10^{25} C. G. S. The average annual rate of loss between 1830 and 1922 is about 1/1,500 part, thus corresponding with the annual average rate as given above.

latitude 78° 32′ north and longitude 69° 08′ west of Greenwich.

For fuller details the interested reader may be referred to the issues of *Terrestrial Magnetism and Atmospheric Electricity* for March–June and September, 1923.

LOUIS A. BAUER
DEPARTMENT OF TERRESTRIAL MAGNETISM,
CARNEGIE INSTITUTION OF WASHINGTON

ALICE C. FLETCHER

IN the year 1881 there appeared on the Omaha reservation, in Nebraska, a white woman. She visited the Indians in their homes and began to make friends with them. At first they were not disposed to talk, but after a time it occurred to one to ask: "Why are you here?" She replied: "I came to learn, if you will let me, something about your tribal organization, social customs, tribal rites, traditions and songs. Also to see if I can help you in any way."

At the suggestion of help the faces of the Indians brightened with hope. The Indian continued: "You have come at a time when we are in distress. We have learned that the 'land paper' given us by the Great Father does not make us secure in our homes; that we could be ousted and driven to the Indian Territory as the Poncas were. We want a 'strong paper.' We are told that we can get one through an act of Congress. Can you help us?"

The little woman replied: "Bring me your 'land paper' and come prepared to tell me about your home and the size of the land you have in cultivation. Come soon." The news spread and the Indians came. Each one uttered the oft repeated cry: "I want a 'strong paper' which will make my home secure, so I can work without fear of being ousted." For days the little friend worked hard writing each man's story of his struggle to live by cultivating the soil. This part of the work being done, she then took up the hardest task, that of framing a petition to be signed by the Indians and sent to Congress, which was something new in her experience.

Here was a woman with a courageous heart, full of true sympathy for humankind, sympathy which found expression, not in well phrased words, but in well planned action. This brave, unselfish woman was Alice C. Fletcher, whom the Omahas learned to love.

The petition was signed and on December 31, 1881, sent to Senator Morgan of Alabama. On January 12, 1882, he wrote that on the 11th he presented the petition and it was recorded. Later a bill was introduced in the Senate for allotting lands to the Omahas and for the issuance of trust patents to them. Miss Fletcher came to Washington to help push the bill through. It passed both houses, was approved August 7, 1882, and became law.

In April, 1883, Miss Fletcher was appointed special agent to carry out the provisions of the law. When she was about to begin her work the older members of the tribe came together for consultation as to how they could best express their gratitude for what she had done for the tribe. They decided to perform for her the ancient calumet ceremony, although it was not customary to give it informally. A notice was given to the people to come, and on the day appointed many came and assembled in an earth lodge. The calumets were set up in their sacred place, and when Miss Fletcher entered as the honored guest the house became silent. Three men arose and took up the symbolic pipes (the calumets) and the lynx skin on which they rested; then, standing side by side, they sang softly the opening song. At the close the three men turned, and facing the people, who sat in a wide circle, sang a joyful song as they moved around the circle, waving the sacred pipes over their heads. Song after song they sang for their friend, of the joy and happiness that would follow when men learned to live together in peace. When the evening was over they told Miss Fletcher that she was free to study this or any other of their tribal rites.

Miss Fletcher carried on her ethnological researches among the Omaha, Pawnee, Winnebago, Sioux, Nez Perce and other tribes. She published many papers descriptive of the life and ceremonials of the tribes she studied. The most important of these papers are: "The Omaha Tribe," which was published in the Twenty-seventh Annual Report of the Bureau of American Ethnology; "The Hako: A Pawnee Ceremony," which accompanies the Twenty-second Annual Report of the Bureau; and "Indian Story and Song from North America," published by Small Maynard & Company, in 1900. Many of the ceremonial songs collected by Miss Fletcher have been used as themes by American composers, notably by Cadman, Farwell and others. She held the Thaw Fellowship, Peabody Museum, Harvard University, from 1891 to the time of her death, but had been an assistant in the same institution at a still earlier period. She was vice-president of Section H, A. A. A. S., in 1896; president of the Anthropological Society of Washington in 1903; and president of the American Folk-Lore Society in 1905.

This great friend of the Indians was born in Cuba on the 15th day of March, 1838; on the evening of April 6, 1923, she passed away in her home, in Washington, D. C.

FRANCIS LAFLESCHE

SCIENTIFIC EVENTS

RAMSAY MEMORIAL FELLOWSHIPS

The Ramsay Memorial Fellowship Trustees announce the following elections to fellowships and renewals of fellowships for the session 1923–24:

A British fellowship of £300 to Mr. Samuel Coffey, M.Sc., London, Ph.D., Leiden, to carry out research at University College, London.

A British fellowship of £300 to Mr. Alan Francis Titley, B.Sc., Bristol, D.Phil., Oxford.

A British fellowship of £300 renewed to Dr. R. W. Lunt, B.Sc., M.Sc., Ph.D., Liverpool, at present working at University College, London.

A Glasgow fellowship of £300 to Mr. Thomas S. Stevens, B.Sc., to carry out research work at the University of Glasgow.

A Glasgow fellowship of £300 renewed to Mr. J. A. Mair, to enable him to continue work at the University of Glasgow.

A Norwegian fellowship of 5,400 kroner, to Mr. Gunnar Weidsmann, to work at Cambridge under Professor Gowland Hopkins.

A French fellowship of the value of £100, *plus* 14,000f., to Dr. H. Weiss, of La Sorbonne, who will work under Professor Sir William Bragg at the Royal Institution (Davy Faraday Laboratory).

A Netherlands fellowship of £300 to Mr. J. Kalff, doctorandus in chemistry of Amsterdam.

A Danish fellowship of £300 to Mr. Kristian Hjandahl, who will continue work at the University of Liverpool.

Appointments to the Canadian, Greek, Italian and Swedish fellowships will be announced shortly.

Since the institution of the Ramsay Memorial Fellowship Trust in 1919, fellowships have been held by twenty-one fellows, not including the new fellowships announced above. Apart from the British fellowships, the Canadian fellowships and the special Glasgow fellowships, the Ramsay fellowships have been held by American, Danish, Dutch, Greek, Italian, Japanese, Norwegian, Swedish and Swiss fellows.

Information has recently been obtained as to some of the posts held by former Ramsay fellows since their occupation of Ramsay fellowships. One British fellow, Dr. A. E. Mitchell, has been appointed assistant lecturer in chemistry at University College, London. The Greek fellow, Dr. B. C. Papaconstantinou, worked under the Greek Minister of War in Asia Minor testing the explosives for the Greek Army, and is now lecturer in physical chemistry at the University of Athens. The Swedish fellow, Dr. Lennart Smith, has been appointed professor of chemistry at Lund. The Swiss fellow, Dr. Charles Naegeli, is assistant lecturer in the chemical laboratory in the University of Zurich.

Another Swiss fellow, M. Etienne Roux, has been granted the degree of doctor of philosophy of the University of Oxford and has been appointed research chemist in the French firm "Matières Colorantes et Produits Chimiques de St. Denis" in Paris. The Italian fellow, Dr. Remo de Fazi, has been appointed professor of general and applied chemistry in the R. Scuola Superiore di Architetture di Roma, lecturer in general chemistry in the University of Rome, and assistant in applied chemistry in the R. Scuola di Applicazione per gli Ingegneri di Roma.

THE INTERNATIONAL PHYSIOLOGICAL CONGRESS[1]

The International Physiological Congress, comprising over four hundred eminent physiologists from all parts of the world, began its sittings in Edinburgh on July 24. Captain Walter E. Elliot, under-secretary for health for Scotland, on behalf of the government, welcomed the members of the congress. It was with some trepidation in these days, he said, that governments approached scientific men, because the happy contempt with which the politician used to regard the scientist had been rudely shaken by the events of the past seven years, and none of them were likely to forget the days of the war, when whole nations were, practically speaking, subjects of gigantic physiological experiments and where the success or failure of some enormous combination might be based on the obscure calculations of some scientist in a laboratory, of whose name rulers of states till then had scarcely been conscious.

Principal Sir Alfred Ewing extended a most hearty and sympathetic welcome on behalf of Edinburgh University. They had had a chair of physiology since 1685 directly, and indirectly the university had made considerable contributions to physiological knowledge, and they did not need to be told of the great work which Sir Edward Schafer, their president, had carried on, and was carrying on, within the walls of the university. His investigations regarding endocrine glands had opened up new vistas in medicine, and perhaps still unexplored vistas in controlled natural health and processes of growth.

Professor Sir Edward Sharpey Schafer, in his presidential address, said he desired to associate the name of Lister with that gathering, because Lister was for several years professor of surgery at Edinburgh, but chiefly on account of the fact that the researches which preceded his great discovery were researches in pure physiology, and were inspired by that great teacher, William Sharpey, who migrated in 1836 from Edinburgh to London, and to whom he himself and many other British physiologists owed, directly or indirectly, their introduction to their science.

A lecture on insulin was delivered by Professor J. J. R. Macleod, of the University of Toronto, who

[1] From the London *Times*.

said that he and his colleagues considered it a very great honor that an account of their researches on insulin should be given so prominent a place on the program. There was no other problem in the whole vast field of medical science that had attracted such diverse groups of workers as that of the relationship between the pancreas and disturbances in carbohydrate metabolism. Professor Macleod sketched the history of the discovery of insulin by Banting and Best, who worked in his laboratories. Insulin appeared to act not in the blood but in the tissue cells themselves. It caused the tissue cells to take up more glucose (blood sugar). "Insulin sets up some process by which, as it were, a vacuum for sugar becomes established in these cells, so that sugar is removed from the blood."

The various theories which have been advanced to explain this removal were discussed, and then Professor Macleod pointed out that insulin, or at least substances resembling it in certain particulars, had been obtained from clams and other shellfish and, in the case of yeast, from the vegetable kingdom.

SYMPOSIUM ON INDUSTRIAL, AGRICULTURAL AND FOOD CHEMISTRY

"Bread" will be the subject for the symposium which will occupy the first half-day of the Industrial Division's session at the Milwaukee meeting of the American Chemical Society during the week of September 10. Under this heading will be presented papers dealing with the following:

1. Flour—Its manufacture.
2. Flour—Its physico-chemical characteristics.
3. Bread materials—How they are purchased, how formulas are set and carried out in production.
4. Control processes—How the baker regulates temperature, flour storage, fermentation rooms, mixer, oven, proof box, cooling rooms; humidity, in fermentation rooms, proof box and oven, synthesized operations, etc.
5. Bread—Its rôle in nutrition. A discussion of the new developments which our growing knowledge of vitamins and nutrition is stimulating.
6. Possibly some discussion of world wheat production, having in mind the probability that within a few decades our increasing population and diminishing wheat acreage will present a most vital problem.

Some of the speakers before this symposium will be: Professor Bailey, University of Minnesota; Professor R. A. Gortner, State Experiment Station of Minnesota; Dr. H. E. Barnard, director, American Institute of Baking; Dr. G. C. Thomas, Atlas Bread Factory, Milwaukee; Professor Worth Hale, Harvard Medical College. Dr. H. E. Barnard, director of the American Institute of Baking, will preside.

The afternoon of the first day's session will be devoted to a joint meeting with the Chemical Education Section under the leadership of Dr. Edgar F. Smith, on "Chemical Education."

THE FRENCH ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE

The annual meeting of the association was held at Bordeaux from July 30 to August 4 under the presidency of M. Desgry, a member of the Academy of Medicine. A list of the sections with their presidents follows: Mathematics, astronomy, geodesy and mechanics, Lieutenant Colonel Perrier; Navigation, aeronautics, civil and military engineering, M. Charles Camichel; Physics, M. Maurice de Broglie; Chemistry, M. Georges Denigès; Meteorology and physics of the globe, M. Luc Picart; Geology and mineralogy, M. Joseph Blayac; Botany, M. Lucien Beille; Zoology, anatomy and physiology, M. Louis Boutan; Anthropology, Dr. Henri Martin; Medical sciences, M. Jules Sabrazès; Medical radiology, Dr. Louis Jaulin; Odontology, M. Louis Quintin; The pharmaceutical sciences, M. Albert Astruc; Experimental psychology, Dr. Angelo Hesnard; Agriculture, M. Ulysse Gayon; Geography, M. E. Camena d'Almeida; Political economy and statistics, M. G. Pirou; Education, M. Julien Ray; Hygiene and public health, M. B. Auché; Sub-section for archeology, M. J. A. Brutauks; for linguistics and quantitative philology, M. J. Depoin.

THE LOS ANGELES MEETING

Arrangements for the seventy-seventh meeting of the American Association for the Advancement of Science to be held in Los Angeles from September 17 to 20 are appropriately in charge of the Pacific Division of the association which will then be holding its seventh annual meeting. The Pacific Division covers a wide range of territory, including over one thousand members. Its meetings have been held successively at San Diego, Stanford University, Pasadena, Seattle, Berkeley, Salt Lake City, and this year at Los Angeles. The Southwestern Division, embracing a membership in Arizona, New Mexico, western Texas and Chihuahua, Mexico, will this year unite with the Pacific Division and the summer session of the association as a whole, holding its fourth annual meeting in Los Angeles.

The Southwestern Division will be represented on the program of the general sessions by the address of its president, Dr. V. M. Slipher, of Lowell Observatory, who will speak on "The Planets" on Monday evening, September 17, sharing the platform with Dr. E. P. Lewis, president of the Pacific Division.

Secretary E. A. Beals, of the American Meteorological Society, reports great interest among meteorologists and foresters in the Los Angeles meeting, with

many important papers already scheduled. It is likely that their presentation will require several sessions. A whole day session is planned for a symposium to discuss the relationship between weather and forest fires.

The meeting of the American Association of Petroleum Geologists which is arranged for September 20 to 22 will be representative of the oil interests of the United States and Mexico and will be a significant event in the development of this important industry and of this branch of geology. The association has a large membership, including many prominent geologists. Their program will be of great general interest. The holding of these sessions following the period allotted for the general convention will afford an opportunity for attendance of which many will take advantage.

Secretary C. O. Esterly, of the Western Society of Naturalists, anticipates an attendance of at least 200 members. One session on Tuesday afternoon, September 18, will be devoted to a joint symposium with the Ecological Society of America on "Evolutionary and Ecological Aspects of Distribution of Plants and Animals in California." Papers will be presented on plant life of the desert by Dr. Forrest Shreve; on different aspects of evolution among desert animals, by Dr. Joseph Grinnell and by Dr. Francis B. Sumner, and on floral elements of California, by Dr. LeRoy Abrams.

One of the significant features of the Los Angeles program will be a joint symposium arranged for Wednesday afternoon, September 19, in which the Physiological Section of the Botanical Society of America, The American Phytopathological Society of America, the American Association of Economic Entomologists and the Ecological Society of America will participate, the subject being "Ecological Factors in the Distribution and Severity of Plant Diseases and Insect Pests."

W. W. SARGEANT,
Secretary of the Pacific Division

SCIENTIFIC NOTES AND NEWS

RAPHAEL PUMPELLY, the distinguished geologist and explorer, died at his home in Newport, on August 10, at the age of eighty-six years.

DR. T. WINGATE TODD, professor of anatomy in the school of medicine of Western Reserve University, Cleveland, has been elected foreign corresponding member of the Royal Academy of Brussels, Belgium. Dr. Todd's election was unanimous, a result which has not occurred in years.

GEORGE W. CARVER, Tuskegee Institute, has been awarded the Spingarn medal for 1922, given annually for the most notable achievement by an American citizen of African descent. Mr. Carver is known for his work in applied chemistry in agricultural products, particularly those of the peanut and sweet potato.

THE DUKE OF CONNAUGHT, president of the Royal Society of Arts, at a meeting of the society in July presented the Albert Medals of the society, awarded to Sir David Bruce and Sir Ronald Ross "in recognition of the eminent services they have rendered to the economic development of the world by their achievements in biological research and the study of tropical diseases."

DR. PINERUA, professor of chemistry, University of Madrid, will be guest of honor at a banquet given in connection with the unveiling of his bust in his lecture hall by former students on his reaching the age limit.

AT the Portsmouth meeting held during the third week of July, Dr. C. P. Childe was elected president of the British Medical Association.

DR. A. RUSSELL has been elected president and Sir James Devonshire vice-president of the British Institution of Electrical Engineers.

SURGEON REAR-ADMIRAL JOSEPH CHAMBERS has been appointed director-general of the Medical Department of the British Navy, in succession to Surgeon Vice-Admiral Sir Robert Hill, to date from October 1, 1923.

S. T. DANA, forest commissioner of Maine, has been appointed director of the northeastern forest experiment station of the Forest Service, which was provided for by the last Congress, according to an announcement by the United States Department of Agriculture. It will cover in its activities the northeastern forest region, including the New England States and New York, with headquarters at Amherst, Mass.

DR. FRANK M. PHILLIPS, who has been with the U. S. Public Health Service for the past four years, has accepted the position of chief of the Division of Statistics, effective August 1. He has been retained as consultant in research in the Public Health Service and in the Bureau of Mines. He is also professor in statistics at George Washington University.

DR. NATHANIEL ALLISON, dean of the Medical School of Washington University, St. Louis, has been appointed chief of the Orthopedic Department of the Massachusetts General Hospital.

DR. LELAND E. COFER has been appointed director of the division of industrial hygiene of the New York State Department of Labor. Dr. Cofer has been an officer in the U. S. Public Health Service for more than thirty years.

M. Jean Bosler has been nominated by the Paris Academy of Sciences for director of the observatory at Marseilles.

Professor Lubarsch has been appointed director of the Robert Koch Foundation for Combating Tuberculosis in place of the late Professor Orth.

Maurice L. Huggins, who has held a National Research fellowship in chemistry during the past year at Harvard University, has been reappointed for the coming year, which he will spend at the California Institute of Technology at Pasadena, carrying on researches in the field of crystal analysis by means of X-rays.

Dr. F. L. Ransome, who has been a member of the U. S. Geological Survey since 1897, leaves Washington on September 6 to take up his new work as professor of economic geology and head of the department of geology at the University of Arizona, at Tucson, Arizona. Dr. Ransome has accepted the appointment for the coming academic year, but has not resigned from the Geological Survey and is under no engagement to remain permanently at Tucson.

Victor Yngve, who has been engaged in cryogenic research at Harvard University during the past year, has accepted a position as director of research for the Manhattan Electrical Supply Co., New York City.

A. T. McPherson, Ph.D. (Chicago, '23), has accepted a position as associate chemist in the Bureau of Standards, where he is engaged in the investigation of rubber and gutta percha as insulating materials.

Lowell H. Milligan, Ph.D. (Cornell '23), has taken a position as research chemist with the Norton Co., at Worcester, Mass.

Dr. J. Walter Fewkes, chief of the bureau of American ethnology of the Smithsonian Institution, has returned to Washington from an investigation of pottery found in the Mimbres Valley in New Mexico.

Charles W. Coulter, assistant professor of sociology in Western Reserve University, has returned to the United States after an absence of over a year in China, where he taught at Nanking University, in Nanking; at Nankai University in Tientsin and in Peking University.

Professor Burton Camp, of the department of mathematics of Wesleyan University, has been granted leave of absence for the college year, 1923–1924. Professor Camp is planning to work at the library of the University of Paris and later to work on the mathematical theory of statistics with Professor Karl Pearson at the Biometric Laboratory of University College, London.

Dr. Wilhelm Segerblom, secretary of the commission to revise the definitions of the requirement in chemistry of the College Entrance Examination Board, writes that the commission desires to have the benefit of all opinion adverse or otherwise on the present syllabus. All teachers who wish to criticize either the chemistry syllabus itself or the examinations set in accordance therewith or who may have constructive comments looking towards improvements in the requirement are requested to send such information to the chairman of the revision commission, Prof. Percy T. Walden, Department of Chemistry, Yale University, New Haven, Connecticut.

The following awards were made at the meeting of the trustees of the Elizabeth Thompson Science Fund on May 28: Dr. E. B. Krumbhaar, Philadelphia General Hospital, Philadelphia, Pennsylvania, for the study of immunity to cancer, $150. Professor H. A. Laurens, Yale University School of Medicine, New Haven, Conn., toward the purchase of a monochromatic illuminator for the visible and ultra violet, $300. Dr. W. W. Swingle, Osborn Zoological Laboratory, Yale University, New Haven, Conn., to aid in the completion of experiments on endocrine glands, $150. The Elizabeth Thompson Science Fund is administered by G. H. Parker, *president*; E. B. Wilson, *secretary*; Charles S. Rackemann, *treasurer*, and G. P. Baxter and W. B. Cannon, members of the board of trustees. The trustees meet three times a year toward the end of February, of May and of November. Applications should be in the hands of the secretary well in advance of the date of the meeting.

UNIVERSITY AND EDUCATIONAL NOTES

By the will of Nettie Fowler McCormick, widow of Cyrus H. McCormick, inventor of the reaper, Washington and Tusculum College at Tusculum, Tennessee, received $100,000.

Boston University has received a bequest of $100,000 from the late Austin B. Fletcher, of New York, a member of the board of trustees.

Dr. Charles A. Kraus, professor of chemistry in charge of graduate work and director of the research laboratories of chemistry at Clark University, Worcester, will join the faculty of Brown University in September, 1924.

Dr. William H. Goodrich, Augusta, has been elected dean of the University of Georgia School of Medicine to succeed the late Dr. William H. Doughty.

Alton Lincoln Smith, professor of drawing and machine design at the Worcester Polytechnic Institute, has been elected to the newly established position of assistant to Dr. Ira N. Hollis, president of the Institute. Professor Smith, who is one of the oldest

members of the faculty, will preside at faculty meetings in the absence of the president and otherwise perform his duties.

Harry S. Smith, formerly chief of the Bureau of Pest Control of the State Department of Agriculture of California, has been appointed associate professor of entomology in the University of California, to be stationed at Riverside.

The French Academy of Sciences has nominated M. Henri Piéron to the chair on the physiology of the senses at the Collège de France.

DISCUSSION AND CORRESPONDENCE

HORSE FLESH IN ENGLAND IN THE ELEVENTH CENTURY

A note on the use of horse flesh in Europe, in Science (N. S. 44 [1916], No. 1140, pp. 638–639), pointed out that, though eaten very generally in earlier times, it went out of use as food as the result of an edict of Pope Gregory III, dating from the eighth century. This prohibition, it would seem, was more effective in Continental Europe than in England. At any rate, a book by W. Boyd Dawkins, "Cave Hunting: Researches on the Evidence of Caves Respecting the Earlier Inhabitants of Europe" (London: Macmillan Co., 1874), gives interesting information about the animals, including the horse, used for food in Roman Britain, and about the abandonment of horse flesh as food because it was again forbidden by the Church, but under different circumstances.

The bones of the Celtic short-horn (Bos longifrons) were found to be very abundant in the Romano-Celtic or Brit-Welsh stratum of the Victoria Cave, Settle, Yorkshire; also those of a variety of the ox indistinguishable from the small dark mountain cattle of Wales and Scotland, which were the chief food of the inhabitants.

A variety of the goat with simple recurved horns, which is commonly met with in the Yorkshire tumuli . . . , and in the deposits round Roman villas in Great Britain, furnished the mutton; while the pork was supplied by a domestic breed of pigs with small canines; and since the bones of the last animal belong, for the most part, to young individuals, it is clear that the young porker was preferred to the older animal. The bill of fare was occasionally varied by the use of horse-flesh, which formed a common article of food in this country down to the ninth century. To this list must be added the venison of the roedeer and stag, but the remains of these two animals were singularly rare. Two spurs of the domestic fowl, and a few bones of wild duck and grouse, complete the list of animals which can with certainty be affirmed to have been eaten by the dwellers in the cave. . . . There were also bones of the dog, which from their unbroken condition proved that the animal had not been used for food, as it certainly was used by the men who lived in the caves of Denbighshire, in the Neolithic age. The whole group of remains implies that the dwellers in the Victoria Cave lived upon their flocks and herds rather than by the chase. And since the domestic fowl was not known in Britain until about the time of the Roman invasion, the presence of its remains fixes the date of the occupation as not earlier than that time. On the other hand, since the small Celtic short-horn (Bos longifrons) was the only domestic ox in use known in Roman Britain, and since it disappeared from those portions of the country which were conquered by the English, along with its Celtic possessors, the date is fixed in the other direction as being not much later than the Northumbrian conquest of that portion of Yorkshire.

Elsewhere in the book the author quoted tells that the

broken bones of the horse [in these caves] . . . leave no room to doubt that horse-flesh was a common article of food at that time. It was so, indeed, throughout Roman Britain, and after the English invasion was used as late as the Council of Celchyth, in the year 787. It was forbidden by the Church because it was eaten by the Scandinavian peoples in honor of Odin. In Norway, Hacon, the foster-son of Aethelstan, was compelled to eat it by the bonders, in 956, and the revolt of the bonders, which ended in the bloody battle of Stikkelstadt, in which Olaf met his death, in 1030, was caused by his cruelties to the eaters of horse-flesh. As Christianity prevailed over the worship of Thor and Odin, it was banished from the table. The present prejudice against its use is a remarkable instance of the change in taste which has been brought about by an ecclesiastical rule aimed against a long-forgotten faith. The rule was not, however, always obeyed, for the Monks of St. Gall, in the eleventh century, not only ate horse-flesh but returned thanks for it in a metrical grace written by Ekkehard the Younger (died 1036): "Sit feralis equi caro dulcis sub cruce Christi."

C. F. Langworthy

Washington, D. C.

EFFECT OF PLANT EXTRACTS ON BLOOD SUGAR

Our studies in connection with insulin led us to the conception that carbohydrate metabolism is performed by an oxidizing ferment mechanism. This theoretical conception induced us to test vegetable material, known to contain oxidases and peroxidases, for oxidizing substances having an insulin-like action. In December, 1922, we injected 5 cc. of juice from a raw potato intravenously into a 1,500 gram rabbit and noted a fall of blood sugar in one hour from 0.17 to 0.13 per cent. Since then we found that sterile pieces of raw potato, and juice expressed from these, introduced into a glucose solution, after incubation for 24

hours at 37 C, caused this to lose from 26 to 36 mg. of glucose per 100 cc.

These results were published in *Journal* of the American Medical Association on June 2, 1923, together with results indicating a diminished glycolytic power of blood from diabetics.

Winter and Smith published a note in the *Journal of Physiology*, 57:40 (Nos. 3 and 4), 1922, which appeared in this country in April, 1923, and in *Nature* of March 10, 1923, that they had obtained an insulin-like substance from yeast.

Collip, in *Nature* of April 28, 1923, states that he, working independently, found an insulin-like substance in various vegetables, in yeast and in clams. Collip's studies on insulin are of inestimable value and made it possible to obtain insulin from animal pancreas in quantities for practical use. He expected to find an insulin-like substance wherever glycogen occurred in nature, and for this reason looked for it in vegetable extracts. Our belief that oxidizing ferments cause glucose metabolism led us to examine vegetables for these ferments and for substances with an insulin-like action. It seems that Collip's theory and ours dovetail. A storehouse of food (glycogen, starch, etc.) and a ferment for the metabolism of this food are necessary wherever growth occurs in vegetables.

Our studies have led us to the tentative suggestion that insulin, which is apparently not itself an oxidase or peroxidase, indirectly stimulates or activates oxidizing ferments in the tissue cells to action upon glucose, whereas vegetable extracts contain active oxidizing ferments and act directly when injected into animals.

It would seem that the work of Winter and Smith, of Collip and of ourselves was being carried on simultaneously and independently. Collip, very properly, suggests that "these authors (Winter and Smith) would, therefore, share coincident priority with me in this particular." We think that we should be included in this share of priority.

WILLIAM THALHIMER
MARGARET C. PERRY
LABORATORIES OF COLUMBIA HOSPITAL,
MILWAUKEE, WIS.

A QUESTION OF RHETORIC

WHY do scientists like to write sentences like the following, which is quoted from the speech of a distinguished man as reported in SCIENCE, "Among the environmental factors which influence the structure and functions of the living organism, nutrition is of primary importance"? The sentence is absolutely correct, and doubtless conveyed the meaning intended to the audience of scientists. But we can sum up the substance of it in three words, "food is important." When so expressed it seems hardly worth saying. Possibly this does not express the meaning quite as accurately as the sentence used, but any doubts that might arise would be fully cleared up in the rest of the speech.

To be sure, more is implied in the sentence used than by the three words, "food is important." There is the suggestion of influencing structural changes by such means, as well as the elimination of any discussion of the effects of heredity, but it is doubtful if many of the scientists in the audience received the full value of such suggestions.

The sentence may have been all right for the audience, but the trouble is that when a person gets used to such methods of expression it is difficult to change when talking to ordinary people. A single unusual word is readily absorbed without breaking the thought. It very often adds to the force of the expression. By unusual word I am not now referring to one that is so unusual that it is not understood, but to one that is not the ordinary expression of the listener. Each such word causes a slight delay in grasping the thought. In the sentence quoted we find seven words which might not convey the thought immediately, and which would therefore be classed as unusual by this definition. Take, for example, the word "primary." The meaning is clear, but how many people would use it as used in ordinary conversation? The only use that most people make of the word "primary" is in connection with the schools.

With seven such words in so short a sentence, a certain amount of mental alertness is necessary to keep up with the speaker, or of concentration to read it. And when the thought reaches home, it is such a commonplace thought that it does not provide any stimulus for concentration on the next sentence.

But why not omit the sentence entirely? Why is it necessary to claim "primary importance" for the subject of nutrition? Would any anatomist deny it?

I do not want to criticize this speaker in particular, but am only pointing out one reason why scientists are not more often asked to explain their observations in publications that pay well. Professor Dry-as-dust is not as often the one whose learning is over the heads of his audience as the one who makes commonplace statements in language that requires an effort to understand it.

A. W. FORBES
WORCESTER, MASSACHUSETTS

QUOTATIONS

MEMORIES OF SIXTY YEARS

THAT a man who became a university graduate in 1859 has published in this year 1923 a volume of vig-

erous and interesting papers and addresses is a fact to encourage other octogenarians not to let their faculties rust. Dr. W. W. Keen, who is in London now to attend the meeting of the International Surgical Society, took part in what he calls the "horrible surgery" of the American Civil War, and has lived to be able to contrast it with that of the world war of 1914–1918. He himself was a pioneer of antiseptic surgery in America, and the longest article in the book is appropriately entitled "Before and after Lister." In other papers he denounces antivivisection, and advocates abstention from alcohol. But the book is not confined to professional subjects. In an address delivered in 1913 in connection with the hundredth anniversary of peace between Great Britain and America, Dr. Keen tells how, a few days before he spoke, he had been one of the signatories to an address beautifully engrossed on vellum, to be presented to the German Emperor, congratulating him on the fact that on June 15 of that year he would complete a twenty-five years' "reign of unbroken peace." Alas! in the following year the Emperor plunged into the great war, and Dr. Keen italicizes his conclusion that the world's hope lies in the amity, cooperation and solidarity of all the English-speaking peoples.

Medical ceremonials seem to have an attraction for Dr. Keen, and he gives pleasantly readable accounts of some graduation and other celebrations in which he has taken part—at Edinburgh, St. Andrews and Upsala. He also tells the story of the early years of Brown University of which he is a graduate. Though the author is now eighty-six years old, his outlook is rather that of a young man, and he concludes his book with a "message of hope" to the sufferers from malignant disease, if only they will seek advice and treatment early. Some of his cases were enjoying life fifteen and twenty years after operation, and he holds that there is a great field for X-rays and radium. Long may he himself continue to write reminiscently for the edification of the generation which is still in the fighting line of medical and surgical duty.—*The British Medical Journal.*

SCIENTIFIC BOOKS

The Preparation and Significance of Free-air Pressure Maps for the Central and Eastern United States. By C. LeRoy Meisinger, Monthly Weather Review Supplement 21, Washington, 1922, 4to, 77 pp., incl. tables, 31 diagr. and 22 charts.

This monograph is a milestone in the progress of American barometry. The last milestone was Frank H. Bigelow's "Report on the barometry of the United States, Canada and the West Indies" (Report of the chief of the Weather Bureau, 1900–1901, vol. II). The foundation of the daily weather map for forecasting purposes has always been the distribution of pressure at sea-level. Sea-level was the natural choice, because the forecasting began as storm warnings for navigators of the ocean. With the spread of the network of meteorological stations over the United States to elevations greater than 1,000 feet, the addition of fictitious air columns of great height in order to get "sea-level pressure" was recognized as a serious source of error. Bigelow very ingeniously patched over this difficulty, in part, but a satisfactory result was not attainable for the elevated western half of the country. Bigelow made an attempt at reducing pressures to levels 3,000 and 10,000 above sea-level, but his temperature argument, based on average temperature gradients of all weather, was too great a source of error. He had done enough, however, to make meteorologists hope for results helpful in forecasting, if accurate maps for levels in the free air could be made. Our weather occurs in the air, not at sea-level underground.

The long-needed revival of free-air pressure maps came as a result of the demands of aerial navigation during the war. Ocean navigation required forecasts from maps of sea-level conditions: now aerial navigation needs forecasts from maps of flying-level conditions. The widely separated observations by means of kites were wholly inadequate for the construction of synoptic free-air pressure maps. But the information gained as to temperatures at different heights provided the data necessary for the construction of reduction tables which could be used at other stations throughout the central and eastern United States. Dr. Meisinger found that for any month the vertical gradient in temperature up to 2 km. over any kite station was practically the same on every occasion with the same wind direction at the ground. He found also that the transitions between kite stations were so smooth that interpolations gave values sufficiently approximate for use over stations where free-air temperatures had not been observed. Thus, the construction of free-air pressure maps for levels such as 1 and 2 km. above sea-level was possible, merely from surface temperatures and wind directions, when based on average temperature gradients interpolated from the kite stations.

The laborious steps by which this possibility was developed into a practicability were, briefly, as follows: First, Dr. Meisinger determined for each kite station the vertical gradient in temperature to 1 km. and to 2 km. above sea-level, with each of the eight wind directions at the ground, in each of the twelve months. These he expressed in terms of the difference between the surface temperature and the mean temperature of the air column to each height. Second, these differences were mapped for each level for each wind direction for each month, lines of equal

difference being carefully interpolated between the kite stations. Third, about thirty Weather Bureau stations were chosen and the values for each determined from the maps, due consideration being given to the altitude of the station as compared with those of the kite stations. Given the surface temperature and wind direction at any station, an approximate mean temperature of the air column could now be obtained, which on substitution in the hypsometric formula would give the pressure at the required level.

Now Dr. Meisinger tested the accuracy of his results by constructing free-air pressure maps from the surface observations at the selected stations and comparing these with observations made at kite and pilot-balloon stations. In spite of errors to be expected from departures of actual from average gradients, owing to (1) the length of time the wind had been blowing from the observed direction, (2) the strength of this wind, (3) the prevalence of unseasonable weather, *e.g.*, March weather in April, (4) the presence of an unusual condition aloft, (5) errors of interpolation and (6) local influences on surface temperature and wind direction, 72 per cent. of the computed barometric values were within 0.05 inch of the observed values, and maps based on computed values were in most cases practically identical with those based on free-air observations made at the time.

From December 1, 1922, to February 28, 1923, 29 stations, each supplied with different barometric reduction tables, made daily postcard reports of computed pressures at 1 and 2 km. above sea-level. Dr. Meisinger checked and mapped the data as they arrived. The forecasters of the central office followed the new maps with interest, and have been considering whether they could be used in daily forecasting sufficiently to justify having the values made a part of the regular morning telegraphic message.

Aeronautical meteorologists and aviators, however, have long since made up their minds, and are asking for upper-air maps as a daily background for the more or less scattered and intermittent indications of winds at flying levels given by pilot balloons and by clouds. At the April 16, 1923, meeting of the American Meteorological Society the troubles of two aviators on the preceding day were cited. In two airplanes they attempted to fly from Moundsville, West Virginia, to Washington, D. C., along the Model Airway. In doing so, however, both had to fly through clouds in winds of unknown speed and direction. One soon descended on a field from which he could not rise. The other, after some very trying hours in the cloud, landed in the vicinity of Quantico, Virginia. A map of winds aloft, computed from maps of pressures at the 1 and 2 km. levels, would probably have been sufficient in the one case to prevent the mishap, and in the other to reduce the anxiety and prevent going beyond the destination. Pilot balloons are useful wind indicators in clear weather, and clouds in partly cloudy to cloudy weather, but computations serve in all weather. Daily telegraphic maps of computed pressures and winds checked by simultaneous pilot balloon and cloud observations are within reach and can provide the entire eastern half of the United States with fairly reliable indications of winds at flying levels in even the thickest weather.

As our forecasters now forecast the distribution of surface pressure, winds and temperature, so also they can forecast the winds at flying levels 12, 24 or 36 hours in advance. The new barometric reduction tables can be applied to these forecast values to predict the distribution of pressure at the 1 and 2 km. levels, and hence of wind direction and velocity over any part of the central and eastern United States.

The long standing barometric reduction problem of the elevated western states may be attacked along the same lines as in the east, as soon as kite stations are established and records obtained. The computation of pressures at heights greater than 2 km. should also prove practicable by the methods evolved by Dr. Meisinger.

CHARLES F. BROOKS

CLARK UNIVERSITY

Magnetic Declination in the United States for January 1, 1920.[1] By D. L. HAZARD.

THE title of this publication only partly suggests the valuable material it contains. The magnetic declination in the United States, northern Mexico and adjacent waters, referred to January 1, 1920, as well as the present rate of its annual change, is graphically shown on an isogonic chart, scale 1: 7,000,000. The 30 pages of text, however, contain matters of equal interest.

The early land surveys in the United States were made by compass, and boundaries in many old deeds are referred to compass bearings. In order to retrace these the surveyor must not only know the present variation, or declination, of the compass, but must be able to determine what it was at the time of the original survey. This paper contains a table of the values of the declination at one or more places in each state, 108 such places in all, for which the declination is given for each decade since the earliest available determinations, going back in some cases to the year 1750. It is not to be assumed that actual determinations were made at the selected points in each of the years named, but that the tables are made by process

[1] Washington, D. C., U. S. Dept. Comm., Coast and Geod. Surv., *Spec. Pub.* No. 90, 1922 (30 with chart). 23 cm.

of grouping so that a mean result refers to a mean position. This is now possible by reason of the present state of knowledge of the general distribution of declination, and of the general nature of the movement of the secular-variation curves across the country.

The surveyor need not in general concern himself with questions of diurnal variation, but in careful work it should be considered. A table of the mean departure from the mean of day at different seasons at the five magnetic observatories operated by the Coast and Geodetic Survey for each hour of the day is given in convenient form.

A considerable space has been given to detailed methods of finding the true meridian by observations of the sun and of Polaris, so that a surveyor having quite simple equipment may determine for himself the declination at any desired station. Tables are provided so that any person, with nothing more than a plumb-line and simple carpenter's tools, may easily lay off a true meridian anywhere within the United States by observations on Polaris. The tables are extended to the year 1932. More precise methods are explained for those equipped with a surveyor's transit or its equivalent.

While intended primarily for the use of the land surveyor, the book will be found to contain much interest for students and teachers of physics and surveying, supplementing helpfully the rather inadequate chapters on terrestrial magnetism in most general text-books on these subjects.

H. W. FISK

DEPARTMENT OF TERRESTRIAL MAGNETISM

SPECIAL ARTICLES

X-RAYS AND CROSSINGOVER

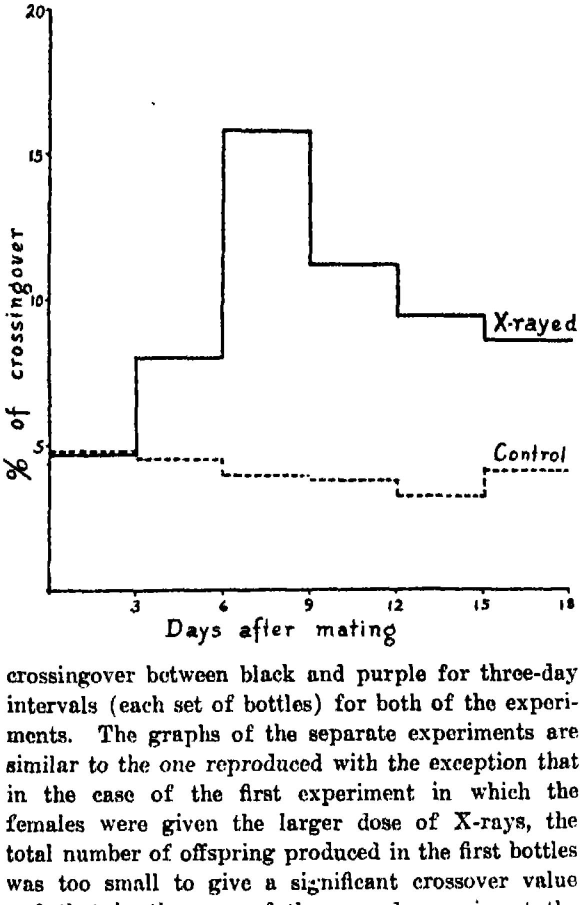
WHEN two or more Mendelian characters which enter a cross from one parent are found to be associated in a greater number of the offspring than could be the case if they segregated independently, the characters are said to be linked. In such a cross the offspring in which the characters are not associated are said to owe their origin to crossingover, the term referring to a process believed to occur in the chromosomes. The percentage of the total offspring in which crossingover occurs is the crossover value for the two characters in question. A small crossover value means a close linkage of the characters and a large crossover value a loose linkage. When a normal, wild-type fruit-fly (Drosophila melanogaster), to take an actual example, is mated with a black-bodied, purple-eyed and curved-winged fly the heterozygous offspring obtain the factors for the three mutant characters from one parent. If now the daughters of such a cross are back-crossed to black purple curved males, a majority of their offspring will be either wild type or black purple curved, showing that these characters are linked (in this case in the second chromosome). There will be also a number of offspring in which the characters are not associated, *e.g.*, normal bodied, purple eyed and curved winged and black bodied, normal eyed and normal winged (crossingover between black and purple), normal bodied, normal eyed and curved winged and black bodied, purple eyed and normal winged (crossingover between purple and curved) and normal bodied, purple eyed and normal winged and black bodied, normal eyed and curved winged (double crossingover). The percentages of crossingover between the characters mentioned have been accurately determined independently by Bridges, Muller and Plough and a summary of their results is given by Bridges and Morgan.[1] They give as the weighted averages of all previous determinations for crossingover between black and purple, 6.2 per cent., the determination having involved somewhat over 50,000 flies, and for crossingover between purple and curved, 19.9 per cent., this determination having involved somewhat over 60,000 flies. It should be added that the determinations by the different investigators are in agreement.

The investigation to be described in the present paper included two experiments. In the first of these twenty sisters from the mating of a wild type female with a black purple curved male were used. Eleven were kept as controls and nine were X-rayed for 3 minutes and 15 seconds at a distance of 23.5 cm from the tungsten target, the Coolidge tube being operated at 50,000 volts and .05 amperes. Previous experiments had shown that the temperature in the X-ray box in which the flies were exposed did not vary from that of the room by more than 1° C. On the day after the X-raying all of the twenty females were mated to black purple curved males and placed in individual culture bottles. The pairs, control and X-rayed, were changed to new bottles every three days until the eighteenth day when they were killed. The offspring coming out in the bottles were counted daily until the seventeenth day after mating. The second experiment was performed in the same way with the following exceptions: the control contained eleven pairs and there were twenty-seven pairs in which the females were X-rayed. The X-ray treatment was the same except that the time was shortened to 3 minutes. The females were mated immediately after being X-rayed and were transferred to new bottles every three days until the twelfth day when they were killed. The flies coming out in the culture bot-

[1] Publ. No. 278 Carnegie Institute of Washington, p. 123.

ties were counted every three or four days until the seventeenth day after mating. The bottles of both experiments were kept in an incubator set at 22° C. and during the whole time the temperature did not go below 20° C. or above 24° C.

Space will not allow the publication here of tables giving the numbers of crossovers and the per cents. and probable errors calculated from them. In figure 1 is a graph of the weighted values of the percentages of



crossingover between black and purple for three-day intervals (each set of bottles) for both of the experiments. The graphs of the separate experiments are similar to the one reproduced with the exception that in the case of the first experiment in which the females were given the larger dose of X-rays, the total number of offspring produced in the first bottles was too small to give a significant crossover value and that in the case of the second experiment the graph does not extend beyond the twelfth day. The control (dotted line) varied from 4.78 per cent. to 3.25 per cent., showing a slight decrease with age until the fifteenth day. This decrease in the crossover value with age has already been reported by Bridges[2] and Plough.[3] The effect of the X-rays on the crossover value (continuous line) becomes apparent in the counts of the offspring of the X-rayed females in the second bottles (the 4th to the 7th day after X-raying in the case of the first experiment and the 3rd to the 6th day in the case of the second experiment). The effect of the X-rays is greatest in the third bottles (6th to 9th day after mating). The fourth, fifth and sixth bottles (9th to 18th day) show a gradual recovery toward the crossover value of the control. The difference between the crossover value in the cultures of the X-rayed and control females divided by the probable error of the difference is for each of the six bottles 0.16, 6.11, 29.14, 20.78, 5.78 and 3.07, respectively.

The data obtained show that X-rays have a similar effect on crossingover between purple and curved although the increase in crossingover is not so great and recovery to the normal crossover value is apparently more rapid. The values of the coincidence of crossingover between black to purple and purple to curved for the cultures of the X-rayed and control females can not be determined with a sufficiently small probable error to admit of an accurate comparison. It may be stated, however, that the values found for coincidence in the cultures of the X-rayed females show no great increase or decrease compared with those of the control cultures.

A careful tabulation and comparison of the percentages of the complementary crossover classes, *e.g.*, normal bodied, purple eyed and curved winged compared to black bodied, normal eyed and normal winged, has shown that the increase in the crossover value found in the cultures of the X-rayed females can not be explained as due to a difference in viability arising from the X-ray treatment of the unfertilized eggs. Such a comparison does not give an absolute proof that the viability of the characters is unaffected by the X-rays since the experiments do not give an opportunity to compare all possible combinations of the characters but it does show that there is not a sufficient difference between any of the classes of offspring of the X-rayed and control females to account for the increase in the crossover value found for the X-rayed females.

It is of great interest to compare the effect which the experiments described show X-rays to have on crossingover in the second chromosome with the effect which Plough[3] has found temperature to have on crossingover. Plough found, using the same characters, that submitting females to temperatures either considerably above or below the normal rearing temperature (22° C.) caused an increase in the crossover value. The X-ray experiments show that X-rays also cause an increase in the crossover value when the flies are kept at a temperature of 22° C. Whereas Plough found that the effect of temperature on crossingover became first apparent on the seventh to eighth day after the beginning of the heat treatment, the X-ray experiments show that the X-ray effect on crossingover becomes apparent on the fourth to seventh day (first experiment) or third to sixth day (second experiment). It is possible that this difference is due to an accelerated development of the eggs due to the

[2] *Journ. Exp. Zool.*, Vol. 19, No. 1.

[3] *Journ. Exp. Zool.*, Vol. 24, No. 2.

X-rays although no other evidence of acceleration is evident in the experiments, *e.g.*, earlier hatching out of offspring of X-rayed flies. A more striking difference is that while the effect of temperature lasts for a time corresponding to the period of time treated and then disappears abruptly the effect of an X-ray treatment which lasted only 3 minutes and 15 seconds starts on the third to sixth day, reaches a maximum on the sixth to ninth day, and then gradually falls off, the effect being still evident after fifteen days.

The effect of X-rays on crossingover in the second chromosomes may be compared with the effect of X-rays on crossingover in the first or sex chromosome already recorded by one of us.[4] Here it was found that X-rays decrease the crossover value for eosin eyed and miniature winged, the effect increasing with the dose. After a dose approximately the same as that given in the first of the experiments on the second chromosome the crossover value for eosin and miniature was decreased from approximately 25 per cent. to less than 10 per cent. and the effect continued from the sixth to the twelfth day after the treatment. We see, then, that X-rays produce opposite effects on crossingover in the first and second chromosomes of Drosophila. This and the duration of the effect suggest that X-rays act on the individual chromosomes affecting them in such a way that crossingover, when it occurs, is modified.

JAMES W. MAVOR
HENRY K. SVENSON

UNION COLLEGE,
SCHENECTADY, N. Y.

[4] *Proc. Soc. Exp. Biol. and Medicine*, Vol. 20, p. 335.

THE IOWA ACADEMY OF SCIENCE

THE academy met at Cornell College, at Mount Vernon, on April 27 and 28. The opening session was held on Friday afternoon, the 27th, and included, besides the transaction of preliminary business, addresses by three invited speakers. The sections of the academy met at 3 P. M. for reading of papers and at 6 o'clock held their group dinners. President Wylie gave his address on "Experiences in Fiji and New Zealand" at the evening session, after which the faculty of the college held an informal reception for the visitors.

On Saturday morning the sections completed their programs, after which the academy convened for the final business session. The academy took some forward steps in adopting resolutions looking towards an extensive biological survey of the state, in establishing a committee on coordination of scientific research, and in endorsing the plan to establish a national museum and aquarium of fishes in honor of Spencer Fullerton Baird. In adopting the report of the committee on the secretary's report the academy provided for the appointment of a permanent committee on publication which should report to the academy a set of rules and suggestions for preparation and publication of papers. The academy transferred eighteen Associates to the class of Fellows and elected nine new Fellows and sixty Associates. It voted to meet with the State College at Ames in 1924, when Dr. L. H. Pammel, who has been a Fellow of the Academy since 1889, will have completed thirty-five years of service with the State College.

The following were elected officers for the ensuing year: *President,* L. H. Pammel, State College, Ames; *vice-president,* O. H. Smith, Cornell College, Mount Vernon; *secretary,* James H. Lees, Iowa Geological Survey, Des Moines; *treasurer,* A. O. Thomas, State University, Iowa City. *Chairmen of Sections: Botany,* J. N. Martin, State College; *chemistry,* Anson Hayes, State College; *geology,* E. J. Cable, Teachers College, Cedar Falls; *mathematics,* F. M. McGaw, Cornell College; *physics,* J. W. Woodrow, State College; *zoology,* F. M. Baldwin, State College.

After luncheon the academy took a trip to the Palisades of the Cedar, one of the most beautiful localities of central Iowa and a delight to geologists and botanists in particular.

PROGRAM

Teaching and learning a local flora: HENRY S. CONARD. An account of progress in preparing and using keys and manuals to the flora of Grinnell and urging the need of local manuals for several districts of the state.

The field of ornithology: T. C. STEPHENS.

The application of laboratory methods to the study of mental diseases: SAMUEL T. ORTON.

Mathematics

Iowa Section Mathematical Association of America

Abstracts of these papers will be found in the journal of the American Mathematical Association.

On the correction of a common error in the calculation of the mean deviation from a given frequency distribution: H. L. RIETZ.

On the geodesic in four space: CORNELIUS GOUWENS.

A general expression for the schediastic function for the generalized double frequency distribution: E. R. SMITH.

Leibnitz's contribution to the history of complex numbers: R. B. MCCLENON.

Some curves met with in the conformal representation of integral transcendental functions: R. B. MCCLENON.

The definite integral in a first course in calculus: J. V. MCKELVEY.

Certain preliminaries in the calculus: C. W. EMMONS.

The Cochleoïde: ROSCOE WOODS.

On the theory of wave filters with an application to the theory of acoustic wave filters: E. W. CHITTENDEN.

Some functional equations suggested by the mean value theorem: W. H. WILSON.

The differentiation of the trigonometric functions: W. H. WILSON.

What is mathematics? J. S. TURNER.

An application of finite differences: JOHN F. REILLY.

The cycloid and its companion: ELMER E. MOOTS.

Physics

A new method for stereoscopic projection: JAY W. WOODROW.

Diffusion of alkali salt vapors in the Bunsen flame: GEORGE E. DAVIS.

The progress of research in the Coe College radiological laboratory: SCOTT W. SMITH, Jr. The aim of the laboratory has been to investigate such problems in the physics of X-rays as are of vital importance in the medical science. The important problem in deep therapy is to produce a beam of X-rays of such penetration that it will reach a desired depth within a medium without injury to the skin and intervening tissue, and to determine the intensity of that radiation after it reaches the desired depth. Five factors enter into this problem: Increase in *voltage* increases the penetration of the ray, but even with the use of high voltages the beam contains many harmful soft rays which must be absorbed by a suitable *filter*. After a beam is produced which is as homogeneous in penetrating rays as possible, it is further found that increasing the *distance* from the tube to the skin, also increasing the *area* radiated, increases the percentage of the beam which reaches the desired depth. However, increasing these factors beyond a certain limit is neither desirable nor profitable, as the increase in penetration beyond that point would be more than offset by the increase in *time* to give a certain amount of radiation. A detailed study of the distribution of the radiation under the variation of these factors has been undertaken by this laboratory.

Calibration of a gold leaf electrometer for ionization work: LEROY D. WELD. In the ordinary types of ionization electroscope having a straight scale, the scale intervals are not proportional to the discharge. A simple quadratic calibration formula is here developed, containing only one constant, whereby the readings can be transformed into those of a scale of equal discharge intervals, and the method of obtaining the constant is explained. Rates of fall on the actual and corrected scales are also compared by means of a linear formula. The calibration is of particular importance in the case of shortlived radioactive products, with which the usual method of fall between fixed points can not be applied, because there is not time to recharge the electroscope. Numerical examples are given illustrating the theory.

Acoustic wave filters in solid media: V. C. HALL.

An extension of acoustic wave filter theory: G. W. STEWART.

New vibrations within a conical horn: VICTOR A. HOERSCH.

The "K" and "L" X-ray spectra of tungsten: C. B. CROFUTT. This paper is a partial report on the complete investigation of the X-ray spectra of tungsten, both emission and absorption. It deals only with the emission and absorption spectra of the "K" and "L" regions. The "M" region is being investigated by Mr. R. V. Zumstein. The X-ray spectra of tungsten have been the most extensively investigated of any element. However, the work has been done at different times by experimenters using different apparatus and methods. For this reason it seemed advisable to make a complete investigation, using as near as possible the same apparatus and conditions throughout. Previous work has been done either on the emission spectra or the absorption spectra and no attempt has been made to get both at the same time under the same conditions. In the present work both have been obtained on the same photographic plate at the same exposure. This furnishes a very accurate method of measuring relative wave lengths. The apparatus used in the work consisted of a high voltage transformer, Coolidge tube and X-ray spectrometer. A few improvements in the method of rotation of the crystal made it possible to greatly prolong the time of exposure. When this work was begun there were twenty-two lines known in the "L" series of tungsten. Out of these twenty-two lines one had been found only by Siegbahn and Duane, three by Dershem and Overn and one by Overn. In the present work all of the above lines except the one found by Siegbahn and Duane have been obtained. In addition, three new lines have been found and two others have been resolved into two components. The most important result of the work on the "L" series is the slight shift obtained in the result given by Duane on the absorption wave lengths, which have been considered as the most accurate. This shift is sufficient to change the relative positions of two of the absorption lines with respect to that of the emission lines. Since both the emission and absorption spectra are obtained on the same plate at the same exposure there can be no question as to the relative positions of the lines. The results to date on the "K" series show that the line is made up of two components. The "K" absorption band has been obtained in the third order on the same plate with the emission lines.

Scattering of homogeneous X-rays by liquid benzene, mesitylene and octane, and by diamond splints: C. W. HEWLETT. I. Scattering curves for liquid benzene, mesitylene and octane. The X-radiation from a molybdenum X-ray tube was filtered through a ZrO^1 screen which reduced the Mo K α (.710A) line very little but cut the other lines and the general radiation to a very small amount. The intensity of the radiation scattered by the liquids contained in a small capsule placed at the center of a spectrometer was measured by the ionization method for angles 8° to 16° on each side of the principal maximum which these liquids show. The principal maximum for octane due to the K α line is 8.12A, for benzene 8.45A, for mesitylene 6.45A and 10.08A. The spacing of the planes of atoms responsible for these maxima in octane is 5.0A, in benzene is 4.8A and in mesitylene is 6.3A and 4.1 Angstroms. For each liquid a hump is noticed at an angle less than the angle of the principal maximum, but this is shown to be due to the general radiation which gets through the filter. II. The temperature effect of the scattering of X-rays by diamond splints. The intensity of X-radiation scattered by diamond splints at room temperature and at 300°C. was measured for the angles 2° to 165°. There is a shift of the maxima due to the expansion of the crystal. The results, however, would indicate that the expansion is not

the same in all directions. The total scattered radiation at the two temperatures was found to be the same within one per cent.

Demonstration of the variable character of the vowel e: G. W. STEWART.

Production of high amperage in a low voltage Coolidge tube: R. V. ZUMSTEIN.

The traces left by a helical beam of electrons on a plane perpendicular to its axis: C. J. LAPP.

A new high frequency alternating current generator: C. J. LAPP.

A summary of recent experiments on the relation between direct and calculated reflecting powers of crystals of tellurium: L. P. SIEG.

A report of progress on the determination of the optical constants of selenium and tellurium in the ultra-violet region: R. F. MILLER.

The light-energy of 2536A required to render developable a grain of silver bromide: P. S. HELMICK.

The natural ultra-violet frequency of silver bromide: P. S. HELMICK.

The reflecting and the absorbing power of a photographic emulsion: P. S. HELMICK.

The torques and forces between short cylindrical coils carrying alternating currents of radio frequency: W. A. PARLIN.

Magnetic and natural rotatory dispersion in absorbing media: E. O. HULBURT.

The distribution of intensity in the broadened balmer lines of hydrogen: E. O. HULBURT.

The deflection of a stream of electrons by electromagnetic radiation: E. O. HULBURT.

On super-regeneration: E. O. HULBURT.

Standards of capacity: J. B. DEMPSTER, E. G. LINDER and E. O. HULBURT.

Zoology

The genus Empoasca in North America: ALBERT HARTZELL. A systematic and biologic study of Empoasca of the Nearctic region with descriptions of new species. A detailed study of the biology of *Empoasca unicolor* and a summary of the life history and habits of *E. mali* are discussed. The phylogeny, geographical distribution and economic importance of the genus are emphasized.

On the function of the paddle of the paddlefish: H. W. NORRIS.

A new apparatus for measuring deep water temperatures: FRANK A. STROMSTEN.

Temperature measurements of Lake Okoboji for August, 1922: FRANK A. STROMSTEN.

A zoological park in New Zealand. DAYTON STONER.

The 1918 outbreak of sod web worms in Iowa: R. L. WEBSTER. An account of the general conditions surrounding this outbreak. Relations between precipitation and severity of the losses from the insect.

Observations on Sphenodon punctatum in captivity: WENDELL KRULL.

Parthenogenesis, sex-determination and patrocliny in the wasp, Habrobracon: ANNA R. WHITING and P. W. WHITING.

An instance of polymely in the frog: ALBERT KUNTZ. A supernumerary fore limb located in the right sternal region is described. The humerus was movably articulated with a supernumerary pectoral girdle consisting of three components. The manus and the distal portion of the radioulna were reduplicated. Probably the humerus also represents fusion of two bones. The limb contained neither muscles nor nerves and exhibited no spontaneous movements. This limb probably arose from a portion of the right anterior limb bud which became separated and displaced from the remaining tissue in the limb bud area.

Check list of birds of Wapello county, Iowa: CHAS. J. SPIKER.

Foods of fishes and the relation to fish culture: WILLIS DERYKE. The conclusions as presented are based on data secured by examinations of fishes of Winona Lake, Indiana. It is quite evident that fish of the same species require different foods at different ages, that fish are somewhat selective as to their food and that these habits make necessary a long food chain. This food chain must then be produced for the successful and most efficient method of fish propagation and culture. While the raising of fry to stock our streams and lakes is a very valuable and necessary work, it is also true that the study of what fish do eat and an attempt to establish the required natural food chain is equally important.

Some modern tendencies in zoological collections and exhibits: F. L. FITZPATRICK.

The food of the short-nosed gar-pike (Lepisosteus platostomus) in Lake Okoboji, Iowa: GEORGE E. POTTER. Collections of these fish were made, stomachs dissected, the contents examined and described. The hour of the day, temperature of air and water, region of the lake in which taken and method of taking are all given from records made for several individuals at the time of collecting. The results show that, in this lake, this fish feeds upon 60 per cent. other fish and 40 per cent. crayfish. Mention is made of the findings of several men who have worked on the food of fish. A short bibliography is appended.

The relation of vitamine deficiency to muscle fatigue in rats: V. E. NELSON and F. M. BALDWIN, in cooperation with ANNA R. RIGGS and MARJORIE CUNNINGHAM.

Comparative rates of oxygen consumption in certain marine forms: F. M. BALDWIN.

Some food reactions of snails: ERWIN W. JOHNS.

The rôle of vagi on gastric motility in Necturus maculatus: T. L. PATTERSON.

The banana snake, Boa imperator: J. E. GUTHRIE. The small boa often found in bunches of bananas is the Central American boa, *Boa imperator,* closely related to *Boa constrictor* of South America. These "banana snakes" are non-poisonous, and are very gentle, at least when young. The young ones found in banana bunches are usually from two to four feet long. Adults are said to reach nine feet. Notes are given on a captive specimen kept under observation for about nine months.

The terrestrial isopods of Iowa: MAYNE LONGNECKER.

JAMES H. LEES,
Secretary

(To be concluded)

Cornell University Medical College

First Avenue and Twenty-eighth St.

NEW YORK CITY

The first year of the course is also offered at Ithaca, N. Y., subsequent years at New York City only.

For information address
THE SECRETARY

COMPLETE STOCK OF

C. A. F. Kahlbaum's Chemicals and Reagents

also

Baker's Analyzed Chemicals

and

Dr. Gruebler's Biological Stains

For Prompt Shipment

C. P. CHEMICAL & DRUG CO
(Incorporated)

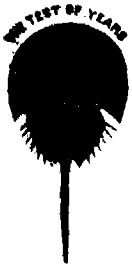
114 Liberty St. New York City

Phone—Rector 4787

Marine Biological Laboratory

Woods Hole, Mass.

Biological Material



1. ZOOLOGY. Preserved material of all types of animals for class work and for the museum.
2. EMBRYOLOGY. *Stages of* some invertebrates, fishes (including Acanthias, Amia and Lepidosteus), Amphibia, and some mammals.
3. BOTANY. Preserved material of Algae, Fungi, Liverworts, Mosses, Ferns and Seed Plants.
4. MICROSCOPE SLIDES in Bacteriology, Botany and Zoology.
5. LIFE HISTORIES, Germination Studies, and Natural History Groups.

Catalogues furnished on application to

GEORGE M. GRAY, Curator

WOODS HOLE MASSACHUSETTS

THE MICROSCOPE

By SIMON H. GAGE of Cornell University

13th Edition, Published December, 1920

In this edition, special emphasis is put upon the Dark-Field Microscope.
POSTPAID, $3.00.

Comstock Publishing Co., Ithaca, N. Y.

"TURTOX" CATALOGS include

Aquaria
Bird glasses
Charts
Chemicals
Dissecting outfits
Earthworms (special)
Entomological supplies
Glassware
Lantern Slides
Life Histories
Microscopes
Microscope slides (General)
Microscope slides (special for High Schools)
Microtomes
Models
Museum Preparations
Preserved Material for Botany, Embryology and Zoology
Insect Mounts
Skeletons
Syringes, Injecting
Vascula

and many other items.

Items in black type are our own special products. We are Manufacturers and Preparators of Biological Supplies.

TURTOX PRODUCTS

Catalogues to cover any or all of the above items will be sent on request.

GENERAL BIOLOGICAL SUPPLY HOUSE

1177 East 55th Street, Chicago, Ill.

SCIENCE NEWS

PITHECANTHROPUS ERECTUS

Science Service

AFTER thirty years denial to his fellow scientists from all nations, Dr. Eugene Dubois, discoverer of this "missing link" in human evolution, has accorded to the American School for Prehistoric Studies in Europe, under the direction of Dr. Aleš Hrdlička, of the Smithsonian Institution, the courtesy of the first opportunity to make a thorough examination of the original fossils. On their return to Amsterdam on July 16 after an inspection of the original bones at Dr. Dubois's home at Haarlem, the American scientists seemed convinced that this ape-man was more nearly human than formerly believed.

"The examination was in many respects a revelation," according to Dr. Hrdlička. "When Dr. Dubois publishes his detailed study, which he tells me he expects to do before the end of the year, *Pithecanthropus erectus* will assume an even weightier place in science than it has held up to now. None of the published illustrations or the casts now in various institutions is accurate. Especially is this true of the teeth and thigh bone. The new braincast is very close to human. The femur is without question human."

The remains consist of the now for the first time thoroughly cleansed skull-cap, the femur, three teeth, two molars and one premolar. Besides these, there is a piece of a strange primitive lower jaw, a later, but nevertheless still primitive, type of man found in lime deposits in a different part of the island from that of the other bones.

Dr. Hrdlička stated that the original relics are even more important than held hitherto. He predicted that though all controversial points may not be settled, the specimens will assume even a weightier place in science than they have had up to the present.

Dr. Dubois found these ape-man remains near Trinil in the island of Java in 1891, but since then has steadfastly refused to allow other scientists to examine the originals thoroughly, so that they have had to content themselves with the casts and illustrations which Dr. Hrdlička now declares to be inaccurate.

Dr. Dubois demonstrated personally and without reserve the precious specimens which have been withheld from other scientists for over a quarter of a century. The cordial invitation for the Americans to see the originals was transmitted through Dr. Arthur Smith-Woodward, of the British Museum of Natural History, and given to Dr. Hrdlička when he arrived in Europe last month.

Dr. Hrdlička wrote in a report of the Smithsonian Institution several years ago as follows: "On account of peculiar circumstances an attempt to describe first hand the important specimens of Pithecanthropus meets with serious difficulties. It would surely seem proper and desirable that specimens of such value to science should be freely accessible to well-qualified investigators and that accurate casts be made available to scientific institutions. Regrettably, however, all that has thus far been furnished to the scientific world is a cast of the skull cap, the commercial replicas of which yield measurements different from those reported taken of the original, and several not thoroughly satisfactory illustrations; no reproductions can be had of the femur and the teeth, and not only the study but even a view of the originals, which are still in the care of their discoverer, are denied to scientific men."

CALIFORNIA'S WATER POWER

Science Service

"CALIFORNIA'S mountain streams made possible last year the delivery of energy equivalent to a day's work by 4,300,000,000 people, or two and a half times the entire population of the world to-day," Robert Sibley, consulting engineer of this city, said in a report made to the American Society of Mechanical Engineers, in which he described present day water power developments in this state and predicted a still greater future. In making his estimate of the amount of power already harnessed by a network of six California power plants, he assumed that the daily work of a human being is equal to one kilowatt-hour of electric energy.

Explaining how this amount of water-power is obtained, he said: There are no great Niagaras in this empire west of the Rockies, hence the engineer has found it necessary to create artificial waterfalls. His general method is to go up into the mountain gorges, build a dam to store the water, convey this water through a ditch or tunnel, often ten to fifteen miles around the mountain side, at a gradient less than that prevailing in the main run of the stream, and thus create an artificial waterfall of 1,000, 1,500, and often even greater than 2,000 feet vertical drop. Through giant pipes these waters are dropped against water wheels often of record proportions, thereby developing electric power which in turn is transmitted to the farm, to the mine, to the home and to the various industries in the great cities of the West.

In discussing the present extent of water power utilization and future possibilities, Mr. Sibley called attention to the fact that California is a state of such proportions that if the northern boundary could be placed at the Woolworth Building in New York City, the southern boundary would be somewhere near Jacksonville, Florida, and he claimed that if the growth in population continues for the next 27 years at the rate maintained from 1910 to 1920, California will have a population in the generation immediately ahead of over 10,000,000 people.

EXPLORATION OF ANCIENT MEXICAN CIVILIZATION

Science Service

DURING the next ten years American archeologists will intensively study and excavate the ruins of the ancient Maya empires that flourished before the time of Colum-

SCIENCE

VOL. LVIII AUGUST 24, 1923 No. 1495

CONTENTS

SCIENCE: A Weekly Journal devoted to the Advancement of Science, edited by J. McKeen Cattell and published every Friday by

THE SCIENCE PRESS

Lancaster, Pa. Garrison, N. Y.

New York City: Grand Central Terminal.

Annual Subscription, $6.00. Single Copies, 15 Cts.

SCIENCE is the official organ of the American Association for the Advancement of Science. Information regarding membership in the association may be secured from the office of the permanent secretary, in the Smithsonian Institution Building, Washington, D. C.

Entered as second-class matter July 18, 1923, at the Post Office at Lancaster, Pa., under the Act of March 3, 1879.

J. WILLARD GIBBS AND HIS CONTRIBUTION TO CHEMISTRY[1]

THOMAS CARLYLE expressed the thought that "great men are the inspired texts of that divine Book of Revelations whereof a chapter is completed from epoch to epoch, and by some named History." These words acquire singular significance when applied to him of whom it is my privilege to speak to-day. In a very real sense Josiah Willard Gibbs was one of the most "inspired texts" which adorn the pages of the history of science in America. Unfortunately the process of exegesis has proved both difficult and slow, so that Gibbs did not live to see himself fully understood nor the practical value of his discoveries appreciated.

Josiah Willard Gibbs was born in New Haven, Connecticut, February 11, 1839. He was the fourth child and only son of Josiah Willard Gibbs, professor of sacred literature in Yale Divinity School, and of his wife, Mary Anna, daughter of Dr. Van Cleve, of Princeton, New Jersey. He was descended from Robert Gibbs, the fourth son of Sir Henry Gibbs, of Honington, Warwickshire, who came to this country and settled in Boston in 1658. Henry Gibbs, one of the grandsons of Robert Gibbs, married, in 1747, Katharine, the daughter of Hon. Josiah Willard, secretary of the province of Massachusetts. No fewer than six of the descendants of this couple have borne the name Josiah Willard Gibbs. The father of the subject of this sketch was regarded by his contemporaries as a man of unusual erudition. He was remarkable for his extreme modesty and for the conscientious and painstaking accuracy which characterized all of his published work. One of his colleagues in commenting on his uncompleted translation of Gesenius's Hebrew Lexicon wrote, "But with his unwonted thoroughness he could not leave a word until he had made the article upon it perfect, sifting what the author had written by independent investigations of his own." Thus, not only through inheritance but also by precept and example, the son acquired those habits of thoroughness which marked all of his life-work.

Willard Gibbs was prepared for college at the Hopkins Grammar School, New Haven, and entered Yale in 1854. His brilliance as a student is attested

[1] Presented before the historical section of the American Chemical Society at the New Haven meeting, April 6, 1923.

by the fact that during his undergraduate career he was awarded several prizes for excellence in Latin and mathematics. After his graduation in 1858 he continued his studies in New Haven until 1863, when he received the degree of doctor of philosophy and was appointed a tutor in the college for a term of three years. During the first years of his appointment he taught Latin, and in the third year physics, in both of which subjects he had earned distinction as an undergraduate. In 1866 he went to Europe, spending the winter in Paris, and the following year in Berlin where he attended the lectures of Magnus and other notable teachers of physics and mathematics. After spending the winter of 1868–69 in Heidelberg, where Helmholtz and Kirchoff were then lecturing, he returned to his home in New Haven. Two years later he was appointed professor of mathematical physics in Yale College, a position which he filled with distinction until the time of his death, April 28, 1903.

Professor Gibbs was most widely known for his contributions to the science of thermodynamics, and in all of the standard treatises on this subject his name repeatedly occurs. It is probably true that no one ever displayed greater originality in method of treatment or discovered a larger number of important thermodynamical principles than did Gibbs.

In 1873, when thirty-four years of age, he published in the Transactions of the Connecticut Academy[2] his first paper, entitled "Graphical methods in the thermodynamics of fluids." In this paper the reader will be impressed with the author's inclination to employ geometrical illustrations in preference to mechanical models as aids to the imagination. Gibbs recognized the fact that such models seldom fully correspond with the phenomena they are intended to represent and accordingly sought geometrical illustrations of his equations. In this endeavor he probably has had few if any equals. The late Professor Bumstead in commenting on his skill in this direction wrote as follows:

> With this inclination, it is probable that he made much use of the volume-pressure diagram, the only one which, up to that time, had been used extensively. To those who are acquainted with the completeness of his investigation of any subject which interested him, it is not surprising that his first published paper should have been a careful study of all the different diagrams which seemed to have any chance of being useful. Of the new diagrams which he first described in this paper, the simplest, in some respects, is that in which entropy and temperature are taken as coordinates; in this, as in the familiar volume-pressure diagram, the work or heat of any cycle is proportional to its area in any part of the plane; for many purposes it is far more perspicuous than the older diagram, and it has found most important applications in the study of the steam engine. The diagram, however, to which Professor Gibbs gave most attention was the *volume-entropy diagram*, which presents many advantages when the properties of bodies are to be studied, rather than the work they do or the heat they give out. The chief reason for this superiority is that volume and entropy are both proportional to the quantity of substance, while pressure and temperature are not; the representation of coexistent states is thus especially clear, and for many purposes the gain in this direction more than counterbalances the loss due to the variability of the scale of work and heat. No diagram of constant scale can, for example, adequately represent the triple state where solid, liquid and vapor are all present; nor, without confusion, can it represent the states of a substance which, like water, has a maximum density; in these cases the volume-entropy diagram is superior in distinctness and convenience.

His second paper, entitled "A method of geometrical representation of the thermodynamic properties of substances,"[3] attracted the attention of physicists throughout the world. He here selects volume, entropy and energy as the three coordinate axes and proceeds to develop the properties of the resulting *thermodynamic surface*, the geometrical conditions for equilibrium, the criteria for its stability and the conditions for coexistent states, as well as those for the critical state. The importance of this work was quickly recognized by James Clerk Maxwell who, towards the end of his life, constructed a model of such a surface with his own hands and presented a cast of it to Professor Gibbs.

These two papers demonstrated to the world Gibbs's extraordinary powers in the domain of mathematical physics, and presaged the appearance of his most celebrated contribution to scientific literature, entitled "On the equilibrium of heterogeneous substances."[4] This paper, which won for him universal fame, was published in two parts in the Transactions of the Connecticut Academy, the first part appearing in 1876 and the second part in 1878. The author here applied the principles of thermodynamics to the conditions of equilibrium between substances differing not only in chemical properties, but also in physical state. The few attempts which had been made prior to the work of Gibbs to bring chemical action within the scope of the fundamental laws of thermodynamics had proven only partially successful. No broad generalizations, connecting thermal energy and chemical energy, similar to the relations which were known to obtain in the case of mechanical energy, had been established. It was Willard Gibbs who supplied the stroke of genius necessary to the solution of the problem. Not only did he blaze the trail, but in this masterly pub-

[2] Trans. Conn. Acad., 2, 309, (1873).

[3] Trans. Conn. Acad., 2, 382 (1873).

[4] Trans. Conn. Acad., 3, 108 (1876); 3, 343 (1878).

lication he carried the study of the relations between thermal energy and the energy of chemical reaction to a degree of completeness which rivals that of the older theory dealing with mechanical energy. It should be borne in mind that this older theory had to do with a far less complicated subject. As one of his biographers wrote:

The older theory was the work of a number of men whose mathematical deductions were constantly being checked by experiment and who had the stimulus of mutual suggestions from each other's work. Professor Gibbs worked alone in a field in which he had no rivals and no helpers; he published practically all that he had to say upon the subject in a single paper of great length; and there were scarcely any experiments to which he could look for confirmation or suggestion as to his theoretical conclusions. Yet his very numerous results were correct, were of the highest importance, and were extremely general in application. Many things which had been mysteries, and concerning which our ignorance had been confessed by such vague terms as "affinity" or "catalytic action," were in this paper shown to be simple and direct consequences of the two laws of thermodynamics. Relations between facts and laws of chemical action were stated *a priori* which have since been verified by laborious and exact experiments; in fact there is little exaggeration, if any, in the statement that this paper contains, so far as general principles are concerned, practically the whole of the science which is now called physical chemistry and which had scarcely been begun when it was written. Considered merely as an intellectual *tour de force*, there are very few chapters in the history of science which can be compared with this; as an example of scientific prediction it is probably without a rival in the number and complexity of the relations discovered by *a priori* reasoning, in a science essentially experimental.

Notwithstanding the importance of this paper, it was a number of years before its value to the science of chemistry was fully appreciated. The cause of this delay was, in large measure, due to the fact that the author expressed his generalizations in terms of mathematics of which the average chemist of forty years ago was blissfully ignorant.

In 1892 the paper was translated into German by Ostwald and seven years later Le Chatelier translated it into French. In the preface to the German edition, the translator writes:

The importance of the thermodynamic papers of Willard Gibbs can best be indicated by the fact that in them is contained, explicitly or implicitly, a large part of the discoveries which have since been made by various investigators in the domain of chemical and physical equilibrium and which have led to so notable a development in this field. . . . The contents of this work are to-day of immediate importance and by no means of merely historical value. For of the almost boundless wealth of results which it contains, or to which it points the way, only a small part has up to the present time been made fruitful. Untouched treasures of the greatest variety and of the greatest importance both to the theoretical and to the experimental investigator still lie within its pages.

Le Chatelier, in the foreword to the French edition, reminds his readers that

To Professor Willard Gibbs belongs the honor of having created by the systematic use of thermodynamic methods a new branch of chemistry, the importance of which, daily increasing, has now become comparable to that of the gravimetric chemistry created by Lavoisier.

While it obviously lies beyond the scope of this paper to attempt an outline of this remarkable piece of work, it should be pointed out that many of its theorems have served as guides for experimental investigations of fundamental importance, while others have served to classify and explain, in a thoroughly satisfactory manner, the results of numerous researches. No one who is familiar with modern physical chemistry can study this paper without being profoundly impressed by the remarkable clearness with which Gibbs formulated many of its fundamental theorems, despite the fact that so little experimental data was available.

Thus, in his treatment of binary mixtures in which one of the components was assumed to be present in relatively small amount, he deduced the law of dilute solutions which, as is well known, was subsequently derived by Van't Hoff from the experimental data of Pfeffer and Traube.

One also finds a derivation of the exact relationship which obtains between the chemical energy transformed and the maximum electrical energy developed in a reversible galvanic cell. Gibbs clearly pointed out that the total thermal energy of the chemical reaction occurring within a galvanic cell is never completely transformed into electrical energy, unless the temperature coefficient of electromotive force is zero. This same relationship was independently discovered by Helmholtz about four years after the publication of Gibbs's paper; in consequence of this fact its mathematical formulation is commonly known as the "Gibbs-Helmholtz equation."

It was Gibbs who first pointed out, that at the surfaces of dispersed systems, a different concentration is to be expected from that which obtains in the body of the dispersoid. While he did not know or employ the modern concept of dispersed systems, his deductions were of such a general character that they may be applied to the special field of colloids.

Another generalization of interest to the chemist which was first clearly stated in this paper deals with the direction of change of vapor pressure which oc-

curs in the distillation of a mixture of changing composition. This generalization, sometimes referred to as the Gibbs-Konowalow rule, states that a liquid mixture corresponding to a minimum or maximum of vapor pressure at any specified temperature has the same composition as the vapor with which it is in equilibrium.

By far the most important principle enunciated in this wonderfully comprehensive paper, however, is that commonly known as the "phase rule." The Dutch physical chemist, Roozeboom, was the first to recognize the value of this principle in connection with the study of heterogeneous systems, and it is to him that we owe the familiar simplified statement of the theorem as well as numerous illustrations of its applications. The phase rule, as is well known, defines the conditions of equilibrium in a heterogeneous system by the relation between the number of coexisting phases and the number of components constituting the system. It may be briefly stated as follows: A system will be in equilibrium when the number of degrees of freedom is equal to the number of components less the number of phases increased by 2. It may be of interest to mention that Gibbs was the first to employ the term "phase" to signify a discrete portion of matter in which the smallest visible particles are all exactly alike, and which is, therefore, separated in space from every other homogeneous, but dissimilar portion of matter.

The importance of the phase rule in the realm of theoretical chemistry is to-day fully recognized. It has furnished a valuable basis for the classification of closely allied chemical compounds and has proven a trustworthy guide, both in the discovery of new substances as well as in the determination of the range of their stability. Its practical importance is attested by the fact that it forms the basis of modern metallography. The variation of the engineering properties, such as tensile strength, ductility, etc., with varying concentration and varying thermal treatment, can only be satisfactorily elucidated with the phase rule as a guide. The application of the phase rule to the metallurgy of iron and steel furnishes one of the most striking illustrations of its value. The phase rule has proven of inestimable value in connection with the interesting investigations upon minerals and rocks which have been in progress for some years at the Geophysical Laboratory in Washington, while in the ceramic arts and in the manufacture of glass it is destined to play an increasingly important rôle.

In 1879, Gibbs published a paper, "On the vapor-densities of peroxide of nitrogen, formic acid, acetic acid and perchloride of phosphorus,"[5] and a few years later he wrote a series of letters to the secretary of the electrolysis committee of the British Association on "Electrochemical thermodynamics."[6] These papers, together with those previously mentioned, comprise all of his contributions which have a direct bearing upon the science of chemistry.

Besides Gibbs's remarkable achievements in the domain of mathematical physics, he won equally great distinction in the realm of pure mathematics. In his lectures on mathematical physics he became aware of the need for a vector algebra by means of which the complex space relations, so frequently encountered in the study of the theory of electricity and magnetism, could be adequately expressed. To meet this requirement he developed a system of vector analysis for the use of his students. This was at first printed in pamphlet form, but subsequently Professor Gibbs, somewhat reluctantly, consented to its formal publication.

Between the years 1882 and 1889 he published five papers dealing with the electromagnetic theory of light which are regarded by physicists as remarkable for the entire absence of special hypotheses as to the connection between matter and ether.

Professor Gibbs's last work, entitled, "The elementary principles of statistical mechanics," published in 1902, is a masterly exposition of the methods available for the study of systems endowed with several degrees of freedom. This work is said to have opened new vistas to students of mathematical physics.

At the time of his death, in 1903, Professor Gibbs was engaged in the preparation of some additional chapters on heterogeneous equilibrium for a collected edition of his contributions to thermodynamics.

He was the recipient of many honors from learned societies and universities both at home and abroad. Among the societies and academies of which he was a member, or a correspondent, may be mentioned the Connecticut Academy of Arts and Sciences, the National Academy of Sciences, the American Academy of Arts and Sciences, the Royal Institution of Great Britain, the Cambridge Philosophical Society, the Royal Society of London, the Royal Prussian Academy of Berlin, the French Institute, the Physical Society of London, the Bavarian Academy of Sciences and the American Mathematical Society. He received honorary degrees from Williams College, and from the universities of Erlangen, Princeton and Christiania. In 1881 he was awarded the Rumford Medal from the American Academy of Boston, and in 1901 the Copley Medal from the Royal Society of London.

In 1910 a medal was founded in his honor by the Chicago Section of the American Chemical Society to be awarded annually for the best paper or address presented before the section.

[5] *Am. Jour. Sci.* [3], 18, 277, 371 (1879).

[6] Rep. Brit. Assoc. for 1886, p. 388; for 1888, p. 343.

As a teacher, Professor Gibbs is said to have possessed great originality and to have inspired all who came under the spell of his genius. In his classroom there were often revealed

> Rich stones from out the labyrinthine cave
> Of research, pearls from Time's profoundest wave
> And many a jewel bravo, of brilliant ray,
> Dug in the far obscure Cathay
> Of meditation deep . . .

The late Professor Bumstead, who was among those privileged to study under him, writes:

> Although long intervals sometimes elapsed between his publications, his habits of work were steady and systematic; but he worked alone and, apparently, without need of the stimulus of personal conversation upon the subject, or of criticism from others, which is often helpful even when the critic is intellectually an inferior. So far from publishing partial results, he seldom, if ever, spoke of what he was doing until it was practically in its final and complete form. This was his chief limitation as a teacher of advanced students; he did not take them into his confidence with regard to his current work, and even when he lectured upon a subject in advance of its publication, the work was really complete except for a few finishing touches. Thus, his students were deprived of the advantage of seeing his great structures in the process of building, of helping in the details, and of being in such ways encouraged to make for themselves attempts similar in character, however small their scale. But on the other hand, they owe him a debt of gratitude for an introduction to the profounder regions of natural philosophy such as they could have obtained from few other living teachers. Always carefully prepared, his lectures were marked by the same great qualities as his published papers and were, in addition, enriched by many apt and simple illustrations which can never be forgotten by those who heard them. . . . No student could come in contact with this serene and impartial mind without feeling profoundly its influence in all his future studies of nature.

As a man Professor Gibbs was singularly retiring. With the exception of those few years spent as a student in Europe, he lived quietly during the academic year in New Haven and passed his summer vacations among the mountains of New Hampshire. He never married but made his home with his sister and her family. Professor Gibbs was unfeignedly modest with regard to his achievements, so much so, in fact, that those who were nearest to him believe that he failed to realize his remarkable mental endowments. He never permitted the importance of his scientific work to interfere with the most trivial duties as an official of the college, and he was ever ready to give generously of his time to those of his students who came to him for advice or assistance. In looking through some of his correspondence recently, a member of his family was particularly impressed by the patience he displayed in endeavoring to help those who were victims of some scientific delusion. In several instances he carried on lengthy correspondence with such people, even though they might not be open to conviction, in the effort to point out where their fallacies lay. Ex-president Hadley said of him, "his plain way of seeing straight where other people's preconceived ideas compelled them to see crooked was characteristic of the man and of his work from beginning to end." In a review of his collected papers which appeared in the *Nation*, the opinion was expressed that "Josiah Willard Gibbs advanced science the world over more than it has ever been given to any other American researcher to do," while one who knew him intimately said of him, "the greatness of his intellectual achievements will never overshadow the beauty and the dignity of his life."

> Wherever he be flown, whatever vest
> The being hath put on which lately here
> So many-friended was, so full of cheer
> To make men feel the Seeker's noble zest,
> We have not lost him all; he is not gone
> To the dumb herd of them that wholly die;
> The beauty of his better self lives on
> In minds he touched with fire, in many an eye
> He trained to Truth's exact severity.

FREDERICK H. GETMAN
STAMFORD, CONNECTICUT

MEDICAL RESEARCH

MANY of the less reputable characters of history have found charitable interpreters in our time. M. Anatole France, for example, put the case for Gallio in a very favorable light. But Gallio's contemporary, Simon, alleged to have been a sorcerer but perhaps only a psycho-pathologist with a *flair* for promising therapeutic improvements, remains proverbially infamous. Yet, on the evidence, it seems that Simon was treated a little harshly. He appears to have made to the Apostles a proposition which would surely have seemed neither novel nor heinous to the Academic Registrars of the schools of Athens or Pergamos. One wonders what Peter would have said if Simon the magician, instead of merely offering the Apostles a fee for a course of lectures, had invited them, for a substantial consideration, to devote their entire energies to research into one problem of psycho-pathology named by himself. This at least is certain, that any such proposal in the twentieth century would be welcomed by a large majority of the general public and an important minority of the medical profession as a praiseworthy, public-spirited action to which the offensive word "simony" could not possibly be applicable.

The fact is that a great many sensible and honorable men act as if they believe that "the gift of God may be purchased with money," because this, like most false doctrines, contains an element of truth. The element of truth is plain enough. He who is inspired by a Daemon, can not deliver his message, if his bodily needs are not satisfied. It is rank simony—besides being ridiculous—to believe that the offer of a prize of a million will cause a better play than "Hamlet" to be written or finer researches than those of Pasteur to be accomplished; it is not simony but elementary common sense to believe that a nation which condemns poets and research chemists to hopeless poverty is unlikely to breed Shakespeares and Pasteurs.

These considerations are so obvious, their application in the field of art and literature, to *that* manifestation of the Holy Ghost, so universally admitted, that one must suppose the would-be purchasers of discoveries in the field of medicine do not really understand that the operation of the spirit there is comparable with that of the literary or artistic daemon. Perhaps the reason is that no general readers and very few medical men have any sense of the secular continuity of research and its applications. It is not, generally speaking, true that either the rise or decline of a great killing disease, such as tuberculosis or cancer, exhibits discontinuities certainly referable to some one factor. In the popular sense of the words, there is no disease the "cause" of which is more exactly known than tuberculosis. No scientific communications were ever more exact and complete than those in which Koch described and defined the "cause," the living germ, which is responsible for the morbid changes. One might expect—to judge from popular utterances—that failing a knowledge of the "cause" we should be powerless and having such knowledge, omnipotent in our struggle with tuberculosis. An examination of the annual rates of mortality over the last seventy years dispels any such illusion. The discovery of the "cause" has neither accelerated nor slackened the rate of decline. Bubonic plague, again, ceased to be a prime cause of mortality in this country rather more than 200 years before its "cause" was known; knowledge of its "cause" has not enabled us to conquer it in British India. Scarlet fever is (at present) a small factor of mortality, although its "cause" is unknown. Diphtheria, on the other hand, is an important means of death, but its "cause" has been isolated and exactly studied.

From these facts we may infer that the "cause" of a disease, in the popular sense, is but an incident of research, not the goal of a natural philosopher. The professed enemies of research have indeed inferred from some of these facts that laboratory investigation is worthless and, in drawing that inference, have been as illogical as the enthusiasts who conceive medical research as a true adventure of Sherlock Holmes. If instead of reading *about* the work of great investigators we studied the classics of the science themselves, we should find that the great men never expected to pass at once from the isolation of a "cause" to the conquest of a disease—another overworked metaphor of popular medicine. The importance they attached to the discovery of a "cause" was the power it conferred of simplifying the conditions of study, of making it possible to imitate the operations of nature under controlled conditions. We may freely grant that, in fact, at the present time, scarlet fever is a much less formidable disease than diphtheria, although sixty years ago it was probably a more serious disease and that laboratory research has, so far, given us no aid in the struggle against scarlet fever. Even so, in a very real sense, the terrors of scarlet fever are greater than those of diphtheria. The reason is this. The simplification of the issues which the isolation of the bacillus of diphtheria permitted, the consequent possibility of an experimental study of means of immunization, has given us a method of prophylaxis which, however far from perfection it may be, is demonstrably efficient, so efficient that we may be absolutely certain that such rates of mortality as were not uncommon 100 years ago in large populations will never again be seen in a civilized country. We can make no such confident prediction regarding scarlet fever, we have *no* experimentally suggested prophylactic, good, bad or indifferent. If the type of that disease changes again—200 years ago, in Sydenham's day, it was as mild as it is now, sixty years ago it was one of the great killing diseases of childhood—we shall not be much better off than in the influenza epidemic of 1918 and for the same reason. The instances of anti-typhoid inoculation within the sphere of prophylaxis or of salvarsan, within the field of personal cure, are similar. The epidemiological problems neither of the enteric fevers nor of syphilis have been completely solved by the isolation of the "cause," but in each case the isolation has led to a sensible diminution of human misery. But that the isolation of a "cause" shall in fact lead to a right use of the means of discovery which the isolation has rendered possible, another condition must be realized —there must be a man of genius fit to use the tools placed in his hands. It was not the discoverer of the "cause" of enteric fever who devised the vaccine; Ehrlich did not discover the parasite of syphilis. Lister's work would have been impossible without that of Pasteur, but Pasteur could not have done what Lister did. Everybody, I suppose, realizes the greatness of both Pasteur and Lister; nobody wastes time in disputing which was the greater. In the achievement of any great thing many have cooperated; it is

certain that both Lister and Pasteur would have recalled to our memories many names of men, their intellectual peers, who had a part in the work which we associate with them alone. If we consider only the men prominently associated with the advance of knowledge, of research into the etiology, prevention and treatment of some disease with respect to which we have been successful, we shall rarely, perhaps never, be able to name *one* man who deserves the lion's share of credit. In the history of research into typhoid fever, a glorious history, the names of Budd, Pettenkoffer, Eberth, Klebs, Gaffky and Almroth Wright, stand out. They were men who all greatly surpassed the normal standard of intellectual power, but were trained in different schools, and reached their several ends by different means; all were great investigators, not one was a sleuth hound who, having dramatically arrested the villain of the typhoid mystery, received the reward offered by a medical Scotland Yard.

It is just as futile to offer prizes for specific discoveries in medicine as to offer rewards for the composition of tragedies. Perhaps it is more futile, since the cooperative element in scientific discovery is more prominent. The recognition of that element has induced some to think that while it is wrong to attempt to purchase individuals it is right to try to purchase groups. We hear much of the need for team work. But the success of team work in matters of the spirit depends upon the willingness of individuals to act as a team. Even at football, I have heard, one can not manufacture an invincible eleven by bribing star players to form a side. To the business organizer of scientific victories it might seem obvious that the united forces of the best clinician, the best bacteriologist, the best biochemist, the best epidemiologist and the best men in a dozen other specialities, mobilized on the cancer front, would speedily conquer that redoubtable enemy of the middle-aged and elderly. But unless it can first be shown that all these star performers wish to abandon the investigations in which, by definition, they are successful, and are able to work in team, the obvious expedient begins to look very much like the sorcerer's heresy, to be another effort to purchase the gift of God with money.

One is, therefore, led to state certain facts and to base upon them certain principles.

The facts are that no great discovery stands alone and no important advance in medicine has been the result of working with a single intellectual tool. Upon these facts, we ground certain principles, or rather one general principle. It is that the endowment of research, the general support of all who approve themselves worthy to extend the bounds of knowledge in *any* direction, should be a rule of policy, both personal and collective. The rule of Looking-Glass Garden, that if one wishes to meet the Red Queen one walks the other way, holds in other gardens; its meaning was familiar to the psychologist who said that "the foolishness of God is wiser than men; and the weakness of God is stronger than men." It has been the rule of the most successful endowment of research England has yet seen, that administered by the Medical Research Council. If A. B. submits a program of research which, he conceives, will throw some light upon the etiology of acromegaly, let us say, and the council are satisfied that he knows what he is talking about, they do not say to him, "You are evidently an able young man and your idea is good, but acromegaly is a rare disease and kills its units, while cancer is a common disease and kills its thousands, if you will turn your attention to cancer we will give you twice the grant you ask." They do not presume to control the operations of the human spirit; they know that it is quite possible that a research into acromegaly may teach us more about cancer than a specific inquiry into cancer. The wise old physician who endowed the best scientific foundation of Oxford did not insist that his traveling fellows should study any particular thing; he wished them to study and that was enough.

Those who demand that more money should be devoted to research in one particular field, that more attention should be devoted to influenza, to cancer or to some other particularly important matter and sneer at the allocation of grants for "academic" investigations have forgotten this principle and are in danger of the judgment pronounced upon Simon the sorcerer.

Major Greenwood

Hillcrest, Church Hill,
Loughton, England

THE CONSERVATION OF MARINE MAMMALS

The killing of extraordinary numbers of whales from shore whaling stations in different parts of the world during the past few years through the use of improved modern weapons and means of transportation seriously endangers the future of these animals. This situation, coupled with the knowledge of what has occurred in the past to seals, sea elephants and some other marine mammals, has drawn attention to the urgent need of taking steps to bring about proper conservation of all the existing valuable sea mammals.

In the United States, the most active organization gathering and disseminating information on the subject is the Committee on Conservation of Marine Life of the Pacific Division of the American Association for the Advancement of Science, under the leadership

of Dr. B. W. Evermann, Director of the Museum, California Academy of Sciences. The National Research Council, the Bureau of Fisheries of the Department of Commerce, and the Bureau of Biological Survey of the Department of Agriculture, are all taking a lively interest in this subject and desire to assist in developing a practical method of conserving these forms of wild life.

The Natural History Society of British Columbia, under the leadership of its president, Dr. William N. Kelly, is also taking an active part in this conservation movement. In recent correspondence with Dr. Kelly I referred to the difficulty of controlling the taking of whales offshore outside the three-mile limit, to which he replied in part as follows:

> Regarding the taking of whales outside the three-mile limit, the Canadian Act (Statutes of Canada, 1914, Chapter 8, Section 8) has provided for this contingency by forbidding any whale not captured in the manner described by the Act being brought ashore to a Whaling Station for reduction into oil and fertilizers, and it also prohibits any whale being brought to a shore station except by the boat from which it was harpooned.

He adds further that he is

> inclosing a cutting from Lloyd's List, London, 23d of March, 1923, on the Whaling Research Expedition that is about to leave for South Atlantic Whaling Stations and this will indicate that Great Britain is also alive to the necessity of further restrictions for the conservation of these mammals.

The interesting quotation which Dr. Kelly sends reads as follows:

> With regard to the announcement that the Antarctic ship "Discovery" had been purchased by the Crown Agents for the Colonies on behalf of the Government of the Falkland Islands, it is now stated officially by the Colonial office that the vessel is to be employed principally in research into whaling in South Georgia and the South Shetlands, which are Dependencies of the Colony.
>
> There is a very large whaling industry in these Dependencies, and the present amount of scientific knowledge regarding the numbers and habits of the whales is insufficient to enable the industry to be controlled in such a way as to afford security against depletion of the stock. The principal task for which the vessel will be employed is to ascertain the geographical limits of the stock of whales, to trace their migrations, and to form some idea of their numbers and the rate of reproduction. But the expedition will also afford opportunities for adding to scientific knowledge in many other directions, and particularly in oceanography, meteorology and magnetism. The work will be generally on the lines recommended in the report of the Interdepartmental Committee on Research and Development in these Dependencies.[1]

[1] SCIENCE, June 22, 1923, pp. 715–716, contains a more extended notice of this expedition.

The example set by the British Government in beginning definite research work covering the life histories of whales is one that should be extended to cover seals, and other sea mammals, and should be promptly followed by the United States and other maritime nations which are commercially interested in the pursuit of these mammals and in the extended utilization of their products. It is obvious that the present uncontrolled, wholesale slaughter of sea mammals over most of their range and practically throughout the year can result only in their rapid extermination.

During the last century the pursuit of sea mammals was carried on on a great scale and yielded an enormous return in oil, whale bone, hides and furs of fur seals and sea otters. Several species have been nearly or quite exterminated by this pursuit and others will follow without concerted action. Proper control of the hunting of these animals will perpetuate indefinitely the returns from this valuable natural asset.

The success of the fur-seal treaty, whereby, through international action, Japan, Russia, England and the United States safeguard the breeding grounds of the fur seals on the Fur Seal Islands, in Alaska, has been a practical demonstration of the effectiveness of such action. It is to be hoped that a similar treaty between the maritime powers interested may be equally effective in saving the other sea mammals from their threatened extinction.

E. W. Nelson

Bureau of Biological Survey,
Washington, D. C.

SCIENTIFIC EVENTS

INTERNATIONAL CONFERENCE ON STANDARDIZATION

A conference of the secretaries of national industrial standardizing bodies was held in Switzerland from July 3 to 7. Thirteen countries were represented, including all the more important industrial nations of Europe and America. The sessions were held in Zurich and in Baden.

A leading topic discussed by the conference was the interchange of information between the various national bodies during the development of the work in the different countries. At the first conference held in London two years ago, arrangements were made for the systematic interchange of completed work and, to some extent, of information on work in progress. Experience had shown such an early interchange to be extremely important for the work within the different countries from the national viewpoint alone, and quite irrespective of the question of international standardization.

While it was not possible to overcome all the difficulties existing by virtue of the important industrial considerations involved, very substantial progress was made. It is believed that the steps taken will lead immediately to a substantially increased amount of interchange of information during the earlier stages of standardization work, and that the way has been paved for a much more extensive interchange in the future.

Provision was made for continuing the work of the conference on the many administrative problems of common interest, through a loose-knit continuing organization. An example of such work planned by the conference is the translation of technical terms of special importance or difficulty in standardization work. There will gradually be built up such a vocabulary of technical terms, mainly in English, French and German, but supplemented as far as may be feasible and necessary by the corresponding terms in other languages. Another example is the work undertaken by the conference on the classification and nomenclature of standards.

The conference was attended by the following delegates:

AUSTRIA
Austrian Standards Committee for Industry and Trade............Jaro Tomaides

BELGIUM
Belgian Association for Standardization ....G. L. Gerard

CANADA
Canadian Engineering Standards Association ....R. J. Durley

CZECHOSLOVAKIA
Czechoslovakian Standards Society..B. Rosenbaum
R. Matousch
F. Kneidl

Masaryk Academy of Labor, Standards Committee............Jan. F. Kottland

FRANCE
Permanent Committee for Standardization ....Eug. Lemaire

GERMANY
Standards Committee of German Industry ....W. Hellmich

GREAT BRITAIN
British Engineering Standards Association ....C. Le Maistre

HOLLAND
General Committee for Standardization in the Netherlands............J. Goudriaan

ITALY
General Committee for Standardization in the Mechanical Industries...Renzo Curti

NORWAY
Standardization Committee of the Norwegian Industrial Association ....Alf. Erikson

SWEDEN
Swedish Industrial Standardization Committee ....Amos Kruse
Swedish Machine Industries Association ....E. Fornander
H. Törnebohm

SWITZERLAND
Standards Federation of the Association of Swiss Machine Industries ....H. Zollinger

UNITED STATES
American Engineering Standards Committee ....P. G. Agnew

THE BIOLOGICAL LABORATORY OF COLD SPRING HARBOR

ON August 4, a meeting of residents of Long Island and a number of biologists, former workers at the Biological Laboratory, met at Blackford Hall, Cold Spring Harbor, to form a corporation to take over the Biological Laboratory from the Brooklyn Institute of Arts and Sciences. The following are some of the Long Islanders who have joined the corporation: Frank L. Babbott, Robert Bacon, Dr. Richard Derby, Mr. Henry W. DeForest, Mr. Frank N. Doubleday, Dr. George Draper, Mrs. George S. Franklin, Theodore A. Havermeyer, Henry Hicks, Dr. W. B. James, Walter Jennings, Mrs. Otto H. Kahn, R. C. Leffingwell, Nelson Lloyd, W. J. Matheson, Dr. Frank Overton, Mrs. C. C. Rumsey, Mortimer L. Schiff, Henry L. Stimson, John H. J. Stewart, Rosina C. Boardman and others. Among adhering biologists are: Bashford Dean, Harris H. Wilder, H. S. Pratt, A. F. Blakeslee, E. C. MacDowell, Sewall Wright, H. D. Fish, Ezra Allen, John T. Buchholz, L. C. Strong, L. A. Brown, James E. Peabody, Norman MacD. Grier, George B. Jenkins, George F. Sykes, William Smith, Gail H. Holliday, Emilia M. Vicari, E. N. Transeau and J. Walter Wilson. A board of managers composed of eight local members and the following biologists was organized: H. E. Walter, of Brown University; G. Clyde Fisher, American Museum of Natural History, New York; H. M. Parshley, Smith College; Duncan S. Johnson, The Johns Hopkins University; H. D. Fish, University of Pittsburgh; Professor W. W. Swingle, of Yale University, and C. B. Davenport. Steps have been taken to secure the transfer of the laboratory from the Brooklyn Institute to the Long Island Corporation. The board of managers nominated Mr. Reginald G. Harris to act as director for one year during the period of tranfer.

DICTIONARY OF SPECIFICATIONS OF THE BUREAU OF STANDARDS

WORK has been started at the Bureau of Standards on the compilation of material for a dictionary or handbook of specifications for supplies purchased by federal, state and municipal governments and public institutions. This work grew out of a meeting held in May, 1923, of State Purchasing Agents from all over the country, and at which the cooperation of the various states was assured in this matter.

On July 11, a conference was held of various national organizations interested in the preparation and unification of purchase specifications and in their use from the point of view of both the producer and the consumer. This conference was called for the purpose of organizing an advisory committee to cooperate with the Department of Commerce and the National Conference of State Purchasing Agents in the work of formulating purchase standards, specifications and tests. Although no meeting of this advisory committee has yet been held, the various organizations represented are cooperating actively in the actual work of compiling the material for the dictionary, and a great deal of information has been supplied.

Correspondence conducted with the officers of trade associations and the purchasing agents of a large number of municipalities and public institutions has established the fact that all the individuals and groups for which the dictionary of specifications is being prepared will welcome its appearance enthusiastically and cooperate actively in the preparation.

A collection is now being made of all available specifications prepared by the various departments and independent establishments of the federal government and those used by state and municipal governments, public institutions, and the important national trade associations and technical societies. These specifications are being thoroughly card-indexed and classified. Care is being taken to pick out those specifications which are most urgently needed, and due consideration is being given to the attitude of purchasers and consumers toward the existing and the proposed specifications.

GEORGE K. BURGESS,
Director

THE LOS ANGELES MEETING

THE progress of research on the Pacific Coast will be dealt with in an interesting series of papers to be presented at the Research Conference on September 17. The arrangement of this program is in the hands of the local committee which reports the following speakers and subjects:

PROFESSOR ERNEST C. WATSON, California Institute of Technology, on *Research Activities of the California Institute of Technology.*

F. B. SUMNER, Acting Director, Scripps Institution for Biological Research, on *The Scripps Institution.*

ACTING DEAN HERBERT J. WEBBER, University of California Agricultural Experiment Station, Riverside, on *The causes of variation in yield in citrus trees.*

DR. LAIRD J. STABLER, University of Southern California, on *Petroleum research.*

The forty-second regular meeting of the San Francisco section of the American Mathematical Society will be held on Tuesday, September 18. Papers will be presented by Professor E. T. Bell, University of Washington; Professor Florian Cajori, University of California; Professor A. F. Carpenter, University of Washington; Dr. Paul H. Daus, University of California; Mr. H. P. Robertson, University of Washington; Dr. Victor Steed, University of Southern California; Professor Harry Bateman, California Institute of Technology, and others. A very interesting meeting is assured.

W. W. SARGEANT,
Secretary of the Pacific Division

THE FIFTIETH ANNIVERSARY OF THE PENIKESE SCHOOL

AUGUST the thirteenth was celebrated at the Wood's Hole Marine Biological Laboratory as the fiftieth anniversary of the founding of the Penikese school by Louis Agassiz. In commemoration of this school, a bronze tablet has been cast in duplicate with an inscription as follows: "In commemoration of the Anderson School of Natural History established fifty years ago on the Island of Penikese by Jean Louis Rodolphe Agassiz, born 1807–died 1873, the Marine Biological Laboratory, the direct descendant of the Penikese school, erects this tablet, 1923." The original tablet is to be placed on a boulder on the Island of Penikese, and the replica in the Marine Biological Laboratory.

The celebration consisted of speeches by three of the staff of the former Penikese school, Dr. David S. Jordan, Dr. Burt G. Wilder and Professor Edward S. Morse; by one of the former students of the school, Dr. Cornelia M. Clapp; by Professors Hermon C. Bumpus, E. G. Conklin and Frank S. Lillie. It was emphasized that it was Agassiz's methods rather than his conclusions which made him the "master teacher," that he taught his students to get their facts from nature and to think for themselves.

SCIENTIFIC NOTES AND NEWS

THE Academy of the Lincei at Rome has elected W. M. Davis, professor of geology, emeritus, at Harvard University, a foreign member in the class of physical, mathematical and natural sciences.

DR. HARVEY CUSHING, professor of surgery at the Harvard Medical School, has been elected a foreign corresponding member of the Paris Academy of Medicine.

AT the eleventh International Physiological Congress meeting in Edinburgh on July 25 the following members were presented by Sir E. Sharpey Schafer for the honorary degree of doctor of laws: F. Bot-

tazzi, Naples; W. Einthoven, Leyden; W. H. Howell, The Johns Hopkins University; J. E. Johansson, Stockholm; A. Kossel, Heidelberg; H. H. Meyer, Vienna; I. P. Pawlow, Petrograd, and C. Richet, Paris.

DR. JOHN F. KIDD, of Ottawa, has been elected president of the Canadian Medical Association.

SIR STEWART STOCKMAN, chief veterinary officer and director of veterinary research to the Ministry of Agriculture and Fisheries, of Great Britain, has been elected president of the Royal College of Veterinary Surgeons.

SIR WILLIAM POPE, professor of chemistry in the University of Cambridge, and a delegation from the British Association for the Advancement of Science attended the forty-seventh Congress of the French Association for the Advancement of Science, which opened at Bordeaux on July 30.

THE Gordon Wigan prize in chemistry has been awarded to R. G. W. Norrish, of Emmanuel College, the University of Cambridge, for an investigation on "The photochemistry of potassium permanganate." The Raymond Horton-Smith prize has been awarded to Dr. A. B. Appleton, Downing College, for an essay on "Morphogenesis of bone," and to Dr. H. W. K. Vines, Christ's College, for an essay on "Certain physiological functions of calcium salts."

DR. J. LASH MILLER, of Toronto, Canada, was the guest of honor at a dinner given at Los Angeles on July 26 by the Southern California Section of the American Chemical Society. Dr. Miller spoke on the "Method of Willard Gibbs in Chemical Thermodynamics."

MAYOR MOORE has appointed Dr. Blair Spencer, assistant director of public welfare, to be director of public health of Philadelphia, succeeding the late Dr. C. Lincoln Furbush.

HOMER N. CALVER has been elected executive secretary of the American Public Health Association to fill the vacancy caused by the resignation of A. W. Hedrich. Mr. Calver is a graduate in sanitary engineering from the Massachusetts Institute of Technology.

DR. GEORGE A. SOPER has been made managing director of the American Society for the Control of Cancer.

IVAR N. HULTMAN has recently been made chemist in charge of operations at the Kingsport plant of the Tennessee-Eastman Corporation. At the close of the war Mr. Hultman became associated with the synthetic organic chemical department of the Eastman Kodak Co.

A NEW cotton boll weevil laboratory has been established by the Federal Department of Agriculture at Florence, S. C., in cooperation with the United States Bureau of Entomology and the South Carolina Experiment Station at that place. Dr. E. N. Winters will be in charge.

THE campaign to investigate the epidemic of fever at Bucuramanga, Colombia, has been placed in charge of Dr. F. A. Miller, who has been directing the campaign against hookworm in that country under the auspices of the Rockefeller Foundation.

DR. MARK BOYD and M. Magoon, of the Rockefeller commission, are in Rio de Janeiro to organize the anti-malaria campaign.

CAPTAIN ROALD AMUNDSEN, leader of the aerial and marine expedition that left Seattle in June, 1922, is on his way to Nome aboard the United States Coast Guard cutter *Bear*, according to word received on August 15.

LIEUTENANT J. R. STENHOUSE has been appointed master of the research ship *Discovery*, which the British Government will send to South Georgia and the South Shetlands regions, in order to obtain scientific evidence bearing on the whaling problem.

PROFESSOR HELLAND HANSEN has left Bergen, Norway, with an expedition aboard the Bergen Museum vessel, the *Armauer Hansen*, on an oceanographic investigation to measure the speed of the Gulf Stream at various depths.

A SCIENTIFIC expedition, *en route* to Point Loma, Calif., sailed from Havre on August 13 aboard the steamer *France* to witness the total eclipse of the sun on September 10. The party includes Charles Le Morvan, astronomer, and Veillet Lavallee.

PROFESSOR M. F. MILLER, chairman of the department of soils of the College of Agriculture of the University of Missouri, is on leave of absence until the beginning of the second semester, January 27, 1924. He is traveling through the corn belt states making a study of the various soils.

DALE S. CHAMBERLAIN, professor of industrial chemistry, Lehigh University, will spend the ensuing year abroad in the study of industrial fuels. He plans to spend some time at the Imperial College of Science and Technology in London.

DR. HERTHA KRAUS, commissioner of public welfare, Cologne, Germany, is visiting the United States to study welfare conditions here.

ABOUT forty American ophthalmologists and laryngologists arrived at Vienna on August 4, with Professor Mackenzie, of the University of Pennsylvania, to

follow special courses of lectures to be given for them at the University of Vienna.

ON June 24, the fourth anniversary of his death, the body of Luigi Luciani was transported from Rome to the place of his birth, Ascoli Piceno, accompanied by members of his family and representatives of various scientific and civic organizations. A memorial stone was placed at the house where he was born, and a memorial tablet of marble with a bronze medallion was placed at the house in which he spent his youth. Professor Baglioni delivered the address at the public meeting in the theater. Luciani, distinguished for his research on the heart and brain, was rector of the University of Rome and a senator of the kingdom.

DR. R. WIEDERSHEIM, emeritus professor of anatomy at Freiburg, has died at the age of seventy-five years.

PROFESSOR L. HILTNER, president of the Bavarian Botanical Institute, died on June 6.

PROFESSOR J. P. LANGLOIS, of the Paris Conservatoire national des Arts et Metiers, and editor since 1910 of the *Revue générale des Sciences,* died on June 17.

THE deaths are also announced of Dr. F. Krafft, professor of chemistry at Heidelberg, aged seventy-one, and Dr. Josef Nevinny, professor of pharmacology at the University of Innsbruck, aged seventy years.

THE University of Toronto has appointed a committee consisting of German authorities on metabolism: Krehl, of Heidelberg; F. Müller, Munich; von Noorden, Frankfort-on-the-Main; Minkowski, Breslau, and Strauss, Umber and Fuld, Berlin, with Minkowski as chairman, to study the use and bring about the preparation of insulin in Germany.

UNIVERSITY AND EDUCATIONAL NOTES

THE will of Mrs. Mary Clark Thompson, of New York City, contains bequests totalling nearly $1,700,000 to institutions to which she had been in life a liberal benefactress. Vassar, Williams and Teachers Colleges receive $300,000 each. $400,000 goes to the Frederick Ferris Thompson Hospital and $200,000 to Clark Manor House, both being at Canandaigua. Other public bequests are $300,000 to the New York Woman's Hospital and $50,000 each to the New York Zoological Society, Charity Organization Society and the Metropolitan Museum. The Public Library receives her rare books.

FROM the faculty of Emory University School of Medicine, Atlanta, Hubert Sheppard, Ph.D., professor of gross and applied anatomy, has resigned to accept a position at Rush Medical College, Chicago; Dr. R. Henry Baldwin, assistant professor of physiology, has resigned to join the staff of the St. Louis Hospital; Dr. Ernest B. Sare, professor of pathology and bacteriology, has resigned to become pathologist and bacteriologist to the Georgia State Insane Asylum, Milledgeville, and Dr. John Funke has resigned as professor of pathology to resume private practice in Atlanta.

THE following members have been added to the scientific departments of Clark University, and will begin their work with the opening of the fall semester: Dr. Asa A. Schaeffer, who for fourteen years has been head of the department of biology at the University of Tennessee, will join the staff in the department of biology. Dr. Schaeffer has been doing special research work under the auspices of the Carnegie Institution. Dr. Carl Murchison, of Miami University, has been appointed professor of psychology, and will be associated with Dr. Edmund C. Sanford in the conduct of both the undergraduate and graduate studies in that department. Dr. Clarence F. Jones, of the University of Chicago, will be assistant professor in the School of Geography, offering work in economic and commercial geography. Dr. O. E. Baker, of the Department of Agriculture, will be on the staff of the School of Geography during the second semester of the coming year, offering work in agricultural geography and land utilization.

DR. JOHN E. GUBERLET has resigned as parasitologist at the Oklahoma Agricultural and Mechanical College and Experiment Station and has accepted a position in the department of zoology at the University of Washington at Seattle.

DR. K. FASSLER, of Freiburg (Switzerland) has been appointed assistant and reader in mineralogy and geology at Laval University, Quebec.

PROFESSOR ROGER has been reelected dean of the Paris Faculty of Medicine. Professor Pierre Marie resigned his chair in the faculty on August 1.

DISCUSSION AND CORRESPONDENCE

THE PROFESSOR AND HIS WAGES

LET it be granted as a premise that the college professor neither can nor should be paid what he is "worth" to society. He can not be paid what he is worth because, though a salesman, the goods and services which he sells are of varying and uncertain value, depending much upon the personality of the teacher but even more upon the receptiveness of the student. In a given market a yard and a half of cloth has a definite value, but who can say what is the value of a term and a half of lectures on English literature? Student A may find as much pleasure

from being introduced to the kingdoms of literary imagination as he would from a gift of $25,000; Student B may value the same lectures at thirty cents; Student C, finding them anything but inspiring, may passionately declare, "I'd give a hundred never to have taken that course!" In all the professions one finds the same difficulty. What is the "worth" of a physician? First, tell us what is the value of a human life to its owner? What is the worth of a minister? Well, what is the market quotation on souls?

Nor should the standard be "the higgling of the market." Granting that you can get teachers cheaply, you run the risk of getting among them "cheap" teachers, who are dear at any price. The cheapest doctor is usually a quack; the cheapest lawyer a shyster; the underpaid judge takes bribes on the side; the underpaid engineer will give you the costliest bridge. Service of quality is not to be had over the bargain counter. Who would auction off the presidency of the United States to the man willing to take the lowest salary or offer command of the army to whatever general promised to carry on the cheapest campaign? Whatever be the market rate for teaching, there will be no lack of teachers—of a sort. There may even be among them a few competent men who regard teaching, like preaching, as a divine calling, or who are rich enough from private income to disregard salaries. But taking humanity in the mass, to degrade the standard of living of any occupation is to debase the quality of those who follow it.

The income of college teachers should then be fixed by the general condition of the labor market. This does not mean that an exactly equal salary is requisite to keep the professor from leaving the teaching trade for other lines of salesmanship. The rewards of the entrepreneur are and should be higher than those of the salaried man, because his risks are greater. The teacher, like the editor or the bank clerk, may lose his job, but the only capital he has invested in his business is his time and labor and special training. The publisher or banker or retailer of shoes runs the additional risk of losing the money which he has invested. But if we subtract a proper sum for "risk of capital," there is no further ground for discrimination between the rewards of business enterprise and the income for a profession. It is nonsense to urge that the "social prestige" or the "leisure" or the "pleasantness" of the professorship should be a counterweight for inequality of income. In the United States, at any rate, greater social recognition and prestige goes to the captain of industry than to any other man. The leisure of the college teacher is largely a myth. The pleasantness of his occupation, on the other hand, is undeniable; but who ever proposed to cut down the salary of a railway superintendent or the commissions of a bond salesman because he enjoyed his work? Some of the wealthiest men in the United States are hardly happy away from their offices and ticker tape, and they would enjoy a Latin professorship even less than the Latin professor would enjoy a seat on the stock exchange. Such considerations may be dismissed as altogether beside the point.

We need not assume that the average instructor or professor is as able as a captain of finance. For efficient instruction it would suffice to put the college teacher on a par with a competent bond salesman, general merchant or metropolitan lawyer. Let us compare a typical professorial career with that of a comparably intelligent business man. The following estimates will not be far wrong:

PROFESSOR BLANK			JOHN SMITH, MERCHANT	
Age 15—	0	(in school)	$500 a year	(office boy)
Age 20—	0	(at college)	$1,500 "	(clerk)
Age 25—	$600	(assistant)	$2,500 "	(salesman)
Age 30—	$1,500	(instructor)	$5,000 "	(salesman)
Age 35—	$2,500	(assistant professor)	$8,000 "	(sales manager)
Age 40—	$3,000	(associate professor)	$12,000 "	(general manager)
Age 45—	$4,000	(professor)	$25,000 "	(profits as owner)
Age 50—	$4,500	(professor)	$35,000 "	(profits as owner)
Age 60—	Retired on half-pay		$25,000 "	(profits as retired stockholder)

Admitting that not all merchants are as successful as Mr. Smith, the fact remains that not all teachers are as successful as was Professor Blank; the table above gives the relative status of two competent men of similar standing in their respective occupations.

A reasonable standard, which would still allow the business man who risks his capital an additional income as insurance for his business risks, would give Professor Blank at least twice his present salary at each round of the academic ladder. To put it concretely, until instructorships pay $3,000 a year and full professorships $8,000 to $10,000, the business world can always outbid the colleges for the services of able men.

One more point should be considered, the exceptional reward for the exceptional man. Business has its millionaires; education has none, though the economic value to society of the work of the research scientist of the highest caliber may be many times

greater than the value of the ablest banker or railroad president. Wealth depends on industrial method; industrial method depends on invention; invention depends on pure science. Now, there is no need of making our Pasteurs or Faradays millionaires; they will do their work without any such reward. But it would be only a meet recognition to pay the outstanding men of science at least as much as a first-class "realtor" or the business manager of a sizable corporation. If each great university should create, say, ten university professorships paying each $20,000 a year, it is unlikely that science would lose many of its ablest men to less important occupations.

It goes without saying that such salaries should be paid only to men of outstanding originality and achievement. Better have the ten university professorships stand vacant for a decade than have their quality lowered, for half their value would depend upon the signal distinction which they would confer. Ordinarily they should go to men in the natural sciences, where research is of the highest importance to human welfare. But one or two might well be awarded to an Emerson or William James in philosophy, or a Lowell or Hawthorne in literature. The mere "scholar" should be well content with an ordinary professorship at $10,000, the highest reward that could reasonably be demanded for efficient industry without imagination.

Preston Slosson

University of Michigan

THE TEMPERATURE OF MINES

I have been recently getting together some figures of the deep temperatures in the mines of the copper country of Michigan and find that apparently a wave of heat, starting some ten thousand years ago, has not reached the bottom of the deeper mines, so that if one takes the temperature at the bottom of the mine and considers how much it drops every hundred feet towards the surface and continues at the same rate to the surface it would imply a surface temperature of not far from freezing. That is to say, the temperatures at the bottom of the mines are adjusted to surface temperature nearly freezing which we may imagine existed under the ice sheet and the rise in temperature since has not worked that far.

Now in the last *Mining & Metallurgical Journal* there appeared an article on the deepest mine in the world, St. Juan Del Rey in Brazil, and there again we find that the temperature at the bottom as compared with that say 5,800 feet down would indicate a much lower surface temperature than really is the case.

Can any one tell me, and here I appeal to those of your readers who are up in other branches of science, whether there are indications in Brazil of a much cooler temperature only a few thousand years ago?

Alfred C. Lane

Tufts College, Mass.

June 15, 1923

"A HUNDRED POUNDS"

In Science of July 27, 1923, Mr. Samuel Russell, referring to my letter of February 23, explains at some length that a hundred weight is not the weight of a hundred pounds but "consists of 112 standard pounds of 7,000 grains, and is divided into 8 stone of 14 standard pounds."

Clearly this solves the problem: "When does a hundred pounds not weigh a hundred pounds?"

I fear Mr. Russell took my letter more seriously than was intended; regarding it as an unprovoked and wanton assault upon the integrity of the defenceless but upright pound. I meant only to call attention to the irrationality of our present legalized weights. For example: 7,000 grains make a pound, a certain kind of a pound; 5,760 make another kind of a pound; 16 ounces make a pound of a certain kind; and we can all say off-hand how many grains there are in such an ounce! (437.5?). But the worst is yet to come. 8,750 grains, which is one eighth of 70,000 grains, make a stone; and 8 stones (a stone being 14 pounds as we all recall) make a hundred weight, which is not as one might suppose 100 pounds, but 112 pounds.

Hence, 2,240 pounds, or 160 stones, make 20 hundred weights or a ton of a certain kind, equal to 20 times a hundred pounds. The coal dealer buys by the hundred weight or 2,400 pounds and sells by the hundred pounds, gaining just 12 per cent. on each weighing. Or we may say that the consumer loses just that much on each weighing. Is not the former an *appreciation* and the latter a *depreciation* of the pound?

Alexander McAdie

QUOTATIONS

A GREAT BIOLOGICAL LABORATORY

It is the humble, often little-known toil of an army of investigators that gives to scientific research so great a collective value to humanity. The celebration this week of the fiftieth anniversary of the Biological Institute, now known as the Marine Biological Laboratory, at Woods Hole, draws our attention to the valuable work which scientists have been doing in this institution for many years. When it was founded half a century ago at Penikese Island, the sea was a thing of wonder and mystery. Scientific men knew comparatively little of biological life in the ocean and what was known aroused a desire among them to learn more about the forms of life that existed in the sea.

The establishment of the biological institute marked a revolution in the teaching of biology, and in biological research. The institution was situated on the very edge of the sea, and the students had an opportunity to study the sea, and the creatures in it, as nature, and not some text-book writer, has made them.

Louis Agassiz, the famous Swiss naturalist and zoologist, who made Cambridge his home during the later years of his life, was the guiding star of the institution in the early years of its development. Himself one of the greatest scientists of modern times, with investigations in many branches of science to his credit, Professor Agassiz had long desired to establish a practical school of natural science, to be devoted especially to the study of marine zoology. Through the generosity of Mr. John Anderson, who gave to him the island of Penikese in Buzzard's Bay, together with an endowment of $50,000, his ambition was realized. Professor Agassiz immediately set to work, opened the school, and began his studies in marine zoology. His program at the time seemed a revolutionary one. The students were told to discard the abstract textbooks, and substitute for them a first-hand contact with the living forms of the sea. The institution, first known as the Anderson School of Natural History, later became the Marine Biological Institute.

Now the school has won a national and an international reputation. It has added a great deal to our store of knowledge; it has made us better acquainted with the life in the vast ocean depths. This year the institute has 146 students, 168 investigators and 25 instructors, drawn from universities and colleges all over the land, and all inspired with a common desire to add their contribution to human knowledge, no matter how small the individual contribution may be. That is the spirit which wins results in modern science.—The Boston *Transcript.*

SCIENTIFIC BOOKS

Eugenics, Genetics and the Family, being volume one of the Scientific Papers of the Second International Congress of Eugenics. Baltimore, Williams and Wilkins Company, 1923.

Eugenics has diverse associations, and one of the most intimate of these is clearly with genetics and with that study which is being developed in Germany under the title of "Familienanthropologie." The Second International Congress of Eugenics was very fortunate in securing the cordial cooperation of many of the leading geneticists and students of human heredity, as well as anthropologists engaged in the study of family and social groups. Their papers are contained in the first volume of the Proceedings of the Congress. This volume also contains the five general addresses given by Henry Fairfield Osborn, Leonard Darwin, C. B. Davenport, Lucien Ceunot and Lucien March.

As stated, the geneticists are well represented. Professor Jennings gives a paper in his usual clear style on the results of his studies of inheritance in unicellular organisms and Professor McClung on the evolution of the chromosome complex. Bridges and Muller, of the famous Drosophila group of Columbia, write on aberrations in chromosomes and mutation, respectively. Drs. Blakeslee and Belling tell about mutations in the number of chromosomes and its consequences. Professors G. H. Shull and R. R. Gates bring important data from the plant side, and Professors Whiting and Zeleny tell of their work on parthenogenesis and racial mutations, respectively. Mr. R. A. Fisher, of the Rothamsted Experiment Station in England, who is in the first rank of statistical analysts, treats statistically of the consequences of mutation for evolution. Heredity is treated generally by an Algerian zoologist, Legrand, and sex determination by Messrs. A. F. Shull, A. M. Banta and L. A. Brown. Then comes a series of papers relating especially to the genetics of mammals and man. These are introduced by a general statistical paper on mutation in man by Danforth; some papers on the influence of radium and alcohol on mammals by Bagg and MacDowell. Especial studies are given on the inheritance of particular traits, such as mental disorders by Drs. H. A. Cotton, Meyerson and Rosanoff; on tuberculosis by Dr. P. A. Lewis, on cancer by Loeb and Little, on eye defects by Dr. Lucien Howe, on twinning by R. A. Fisher, on finger prints by Professor Kristine Bonnevie (the only woman professor in Norway), on fecundity (in the hen) by C. C. Hurst, on musical traits by Seashore and Miss Stanton. This collection of papers by leading geneticists makes the volume indispensable for the student of genetics in general and human genetics in particular.

In the second part the general paper by Monsieur March on the consequences of war on the birth rate in France will be of great interest at the present time. Inbreeding is treated by Drs. Sewall Wright and Helen D. King from the experimental standpoint, and by Mrs. Ruth Moxcey Martin, Dr. Spinden and Professor W. A. Anderson from the observational standpoint. M. Etienne Rabaud compares the weight of the successive offspring of the same parents. Dr. Banker gives directions for an ideal family history. Dr. F. A. Woods discusses the conification of social groups and Miss Sarah L. Kimball tells of the Mayflower Pilgrims and their descendants. Senor J. J. Izquierdo gives an account of the genealogical history of the Izquierdo family, and Dr. Banker that of the Elihu Burritt group. Two of the descendants of John Humphrey Noyes tell of the Oneida Community experiment. Messrs. A. W. Butler, E. W. Ledbetter, A. H. Estabrook and Mrs. Wilhelmine E. Key de-

scribe some defective families, and Miss Elizabeth Green analyzes the traits of 150 adolescent runaway girls. Finally, mate selection is discussed and analyzed by Professor R. H. Johnson. The book contains also 24 plates, being photographs of the exhibits and giving important data concerning human chromosomes, inheritance of special traits and talents in man and other data of genetical and anthropological interest.

It seems difficult to imagine the accumulation in 450 pages of more concentrated excellence in the general matter treated than is to be found in the papers gathered here. It is clear that every contributor has given his best and has given the results of his own researches. Consequently the volume marks a decided advance in our knowledge of pure and applied eugenics.

CHAS. B. DAVENPORT

Eugenics in Race and State. Vol. II of the Proceedings of the Second International Congress of Eugenics. Williams & Wilkins Co., Baltimore, 1923.

THE two volumes which embody the proceedings of the Second International Congress of Eugenics held in New York in September, 1921, reflect perhaps as well as anything can the present status of the subject of eugenics. The reader who would gain an idea of the achievements, methods of inquiry, the imperfection of existing knowledge and the difficulties confronting the student in this field will find these volumes very instructive in more ways than one. The second volume entitled "Eugenics in Race and State," which is the subject of the present review, covers a wide range of topics. It includes fifty-five contributions—which are too many for adequate treatment, even in a bulky work of 472 pages.

A few of these contributions have only an indirect bearing on eugenics. Some are more or less obviously efforts for the occasion. Others consist of general and theoretical discussions of the type with which every student of the subject is only too familiar. This is perhaps unavoidable in the proceedings of a large general congress on eugenics. The captious critic might find opportunity for diversion were he disposed to pounce upon every contributor who afforded him an opening. But aside from faults which are almost inevitable in such a collection, the second volume of the proceedings, like the first, contains a large amount of valuable information and many useful suggestions and discussions. Much of the investigation in this field can not boast of the precision which is attained in genetics, whose recent emergence from chaos enables its devotees to look with something of condescension, if not scorn, upon the groping efforts of the eugenist.

The first contribution to the volume is by the well-known author of "Les Sélections Sociales," G. Vacher de Lapouge, who argues for the persistence of European races in a state of relative purity despite the frequent intermixture that apparently threatens to obliterate all racial barriers. This is followed by several other discussions of the mixture of racial stocks. Dr. J. A. Mjoen, perhaps the leading figure in the eugenics movement in Norway, presents a suggestive paper on "Harmonic and disharmonic race-crossings," in which evidence is cited for the conclusion that crossing brings about many disharmonies of constitution and that the mingling of distinct races of man should not be encouraged in the light of our present knowledge. He is careful to state that "we must not draw conclusions from one race-crossing to another. Each race must be examined in relation to another race." In view of the extensive migration of peoples now going on in the world, there are few questions in eugenics of greater importance and of more immediate concern than the one discussed in Dr. Mjoen's paper. One statement made by the author deserves to be especially emphasized: "Our opponents generally say that we should wait to take eugenic measures in *general* and steps against race-crossings *especially* until we have more knowledge. I admit that we need and shall seek more knowledge, *much* more knowledge! But—as our experience up to date points decidedly in one direction it will be safer to turn the matter around and say: *Until we have acquired sufficient knowledge be careful!*" In this, as in other matters of eugenic procedure, advantage is often taken of our lack of precise knowledge to advocate a *laissez faire* policy, but, as I have elsewhere contended in agreement with the statement just quoted, the proper logical application of the argument from ignorance of the effects of racial mixture is to counsel caution, and to warn peoples of the danger of taking a step in the dark.

There are two papers on racial amalgamation in Hawaii and one by M. Fishberg on intermarriage between Jews and Christians. In the latter, attention is called to the following racial trends among the Jews: The increasing intermarriage of the Jews with members of other sects; the increasing proportion of marriages between Jews and Christians, "the less devoted they are to the separative rituals of their religion"; the higher proportion of mixed marriages among Jews who are successful in financial, scientific, literary or artistic endeavors; and the small number of children resulting from mixed marriages. "The Jews are not only robbed of the exceptionally able and talented through intermarriage. Wherever it is carried very far, the Jews are more or less completely absorbed by the Christians around them." Interesting facts concerning the vital statistics of the Jews

are given in the next contribution by R. N. Salaman entitled "Notes on the Jewish problem."

There are two papers on the negro question by two of our most prominent writers on statistics, Professor W. F. Willcox and Dr. F. L. Hoffman. The first discusses the distribution of negroes in the United States, and the second deals with negro-white intermixture and is mainly concerned with the unhappy results of marriages between whites and blacks.

Then follows the opening address of the section on practical eugenics given by Major Leonard Darwin on "The field of eugenic reform." This address is general in scope and characteristically judicious and conservative. After advocating the curtailment of the propagation of the feeble-minded, neuropathic and habitually criminal elements of the community, and discussing the relative merits and feasibility of segregation and sterilization, the author turns his attention to the problem of increasing the amount of superior inheritance in the general population. This can not be so well accomplished, he thinks, by encouraging parenthood in a relatively few of the exceptionally well endowed, as by raising the general level of the whole people. Genius he regards (I believe rightly) as the fortunate product of a number of hereditary factors, and if the general level of native intellect could be raised, "the factors needed for the production of a man of genius would exist in greater numbers." In common with probably most eugenists, Major Darwin recognizes that the present differential birth-rate is tending to breed out the brains of the race. As a counteractive, "there ought to be a great moral campaign against the selfish regard for personal comfort and social advancement, for these aims must, in a measure, be sacrificed on the altar of family life if racial progress is to be insured." He speaks of the encouragement of parenthood by "economic methods," but he offers no economic recipe for increasing parenthood of a desirable kind.

In dealing with the multiplication of inferior types, Major Darwin is inevitably led to consider that troublesome stratum of low-grade humanity lying just above the level of mental defectives, but which we can not deal with by the drastic methods which can be applied to the mentally and morally irresponsible. Major Darwin has no definite remedy for this situation. "I hardly know what to suggest," he says, "in the case of those who, in spite of this [financial] pressure persist in procreation in evil surroundings; and perhaps for the present we should concentrate our attention on the attempt to secure general approval of the desire to lessen the output of children under such circumstances."

I have wondered why Mr. Darwin has made no mention of birth control in relation to this difficulty, especially since he has elsewhere discussed it in connection with this very topic. Perhaps, being a visitor in a somewhat puritanical country, and in the city of Anthony Comstock, he may have been restrained by his regard for the proprieties of the occasion from entering upon a subject surrounded by so much prejudice.

A short paper by Dr. Raymond Pearl on "Population growth" is followed by a more extended discussion by Professor E. M. East on the limits imposed by the productivity of the soil to population increase. Then follows a discussion by S. J. Holmes and J. C. Goff on the selective elimination of male infants as indicative of the action of natural selection during the period of infancy. Mr. O. E. Koegel points out the bad effects, both socially and eugenically, of common law marriages, and Dr. H. H. Laughlin describes the present status of eugenical sterilization in the United States. Dr. William McDougall summarizes the investigations on the relation of native ability and social status, and, in an earlier part of the volume, he contributes a short paper advocating a system of pecuniary rewards for superior types of parents. Dr. L. I. Dublin makes a plea for education for motherhood as a means of counteracting the present dysgenic influence of the higher learning.

Space forbids comment on or even mention of several other contributions to this volume, although some of them contain facts and discussions of real value. Both volumes of the *Proceedings* are issued in attractive form, and they are both indispensable to the students of eugenics.

S. J. HOLMES

SPECIAL ARTICLES

MULTIPLE SEEDED BURS OF XANTHIUM

FROM time to time observations are made which suggest that individual plants among the *Compositae* may possibly revert to remote ancestral floral conditions. Several methods of development of the composite type of inflorescence are conceivable, involving spicate or umbellate types in the ancestry. Through whatever source the present capitulum has been derived, it was undoubtedly originally many flowered, a condition persisting in the great majority of species to-day. In certain regions of this vast assemblage of plants there is a marked tendency to reduction in the number of florets in the head. This tendency reaches its highest expression in such genera as *Xanthium* and *Ambrosia*, in which the florets are reduced to two and one, respectively. A morphological study of the inflorescence of *Xanthium* shows that it is to be considered a reduced structure.[1]

[1] Farr, C. H., "The origin of the inflorescences of Xanthium," *Bot. Gaz.*, 59:136–148, 1915.

About nine years ago the writer obtained from Mr. Crevecoeur, of Onaga, Kansas, some burs of *Xanthium* which contained many seeds to the bur. A brief description of these burs and an account of their origin have been given in another place,[2] under the name *Xanthium canadense*, var. *globuliforme* Crevecoeur, and the suggestion was made that they may represent a reversion to the ancestral type from which the evolution of the two-flowered condition of to-day proceeded. Recently Collins[3] noted a case of floral modification in *Crepis capillaris* which he interpreted as a reversion to remote ancestral condition. In this particular case, the reversion of *Crepis* to a form having bract-like paleae subtending the achenes was preceded by hybridization of two strains originally from Sweden and Holland, respectively. In the F_1 generation one of the hybrid offspring had this presumably ancestral type of flower cluster, whereas in the normal flower head the receptacle is smooth.

Collins believes that the evolution of species in *Crepis* may have been brought about by separation of a large group of interacting factors into smaller groups no longer capable of producing the generalized ancestral condition. Hybridization then may simply bring back the full combination of factors necessary to somatic expression of the ancient character.

In the case of *Xanthium* recorded above, the burs were collected in immature condition, and had been stored in an herbarium for some years before they were placed in my hands for study. Viability had been lost, and the opportunity of studying the morphological, physiological and genetic problems connected with this reversion was lost for the time being.

During the last year burs of this same type, with somewhat fewer florets, have been found again in a habitat hundreds of miles from Onaga, and separated by a time interval of fourteen years. The burs were found by Mr. A. A. Hansen, weed expert and extension worker in the Purdue Experiment Station, near Richland, Rush County, Indiana, during the autumn of 1922, and sent to the Field Columbian Museum for identification. Recognizing their scientific interest, Dr. Sherff called my attention to them, and kindly gave me the burs for propagation. Fortunately the seeds were found to be viable, and a number of vigorous plants are now growing in the garden of the Hull Botanical Laboratory. An abundance of material for study is assured.

It is not yet known whether hybridization precedes the appearance of this reversion or not, nor even whether it is a case of reversion. The original information furnished by Crevecoeur indicated that the plants might be hybrids. The writer desires additional field data regarding the frequency with which this peculiar modification arises in nature. The infrequency with which it is reported may be due in part to lack of close observation in the field. Field botanists, ecologists, naturalists and students of local floras from all parts of the United States are requested to observe the *Xanthium* population in their respective localities, and to communicate to me the finding of burs which show a many flowered capitulum.

These modified burs may be recognized by the replacement of the two terminal beaks of the bur by a double circlet of beaks surrounding a depression in the outer end of the bur. The photographs reproduced in the paper cited will assist in identification of burs. Any information regarding the occurrence of this type in nature will aid very materially in its interpretation.

CHARLES A. SHULL
THE UNIVERSITY OF CHICAGO

[2] Shull, Charles A., "An interesting modification in Xanthium," *Amer. Jour. Bot.*, 3:40–43, 1917.

[3] Collins, J. L., "Reversion in Composites," *Jour. Hered.*, 12: 129–133, 1921.

THE IOWA ACADEMY OF SCIENCE. II

Botany

The flora of the Olympic peninsula, Washington: ALBERT B. REAGAN.

The Pyrenomycetes or Black Fungi of Iowa: JESSIE PARISH.

The leaching of calcium from soil: WINFIELD SCOTT.

The relation of moisture content to the viability of seed corn: WINFIELD SCOTT.

Notes on the flora of Pine Creek Hollow, Dubuque county: L. H. PAMMEL.

Notes on plants at Whitehall, Michigan: L. H. PAMMEL and R. I. CRATTY.

The Burdock rust (Bullaria Bardanae) in Iowa: GUY WEST WILSON.

Polygonum in Iowa: G. L. WITTROCK. Examination of material in the herbaria of Grinnell, Ames and Iowa City reveals the presence of twenty species in the state. The distribution of each species is given.

Cuscuta in Iowa: G. L. WITTROCK. Examination of material in the herbaria of Grinnell and Ames reveals the presence of eleven species in the state. The distribution of each species is given, and a key to the species.

Citation of authority for Latin names: HENRY S. CONARD. The writer insists that for all persons who are not specialists in systematic botany, citation of the author of a name is meaningless. It is much more significant to name the manual or monograph consulted in determining the names.

The importance of the aerial environment in the growing of wheat in nutrient solutions: A. L. BAKKE. Growing wheat at three different seasonal periods, it has been

found that there is considerable variation in the composition of the culture giving optimum growth. The kind of culture is dependent upon the kind of environment under which the plant is grown. An optimum or "best" solution can be so regarded only according to the particular environment under which a plant is grown.

Plant observations in the field: B. SHIMEK.

Studies on the cytology of Melilotus alba: E. F. CASTATTER. The paper will cover the development of the anther, the behavior of the pollen mother cells, with special reference to the reduction of the chromosomes, and the formation of the pollen grains.

Some introduced plants in Fiji: ROBERT B. WYLIE.

The arborescent flora of a midwest farmstead: T. J. FITZPATRICK. The paper contains the results of observations made during August, 1922, in Buffalo county, Nebraska, upon dooryard and forestry plantings with respect to the prevalent environmental conditions.

The task of the botanist in Florida: THOMAS H. MACBRIDE. Threefold: 1, to understand the wonderful flora of the peninsula; 2, to save and conserve the forest resources of the state; 3, to aid the entomologists and chemists in the culture of citrus fruits.

A collection of Fiji and New Zealand Myxomycetes: THOMAS H. MACBRIDE.

Some Polypores found in Henry county: MARYE CARNAHAN.

Methods of modeling the Agaricaceae: KATHRYN GILMORE.

A study of growth of trees as revealed by the annual rings: MAX W. VAN HORN.

The germination of some trees and shrubs, and the juvenile state: L. H. PAMMEL and CHARLOTTE M. KING.

A day in Muskogee, Oklahoma: L. H. PAMMEL.

The occurrence of the dwarf Juniper (Juniperus horizontalis) near Rockford, Iowa: L. H. PAMMEL. A number of years ago Mr. Clement Webster and C. Harold Brown, of Charles City, sent to the writer a specimen of what he determined to be the above juniper. He wanted to make sure that the plant was not introduced. He had an opportunity last summer to not only confirm the identification previously made, but to determine that the plant was a native to the region; so far as he knows, the only locality in Iowa. Robinson and Fernald give the distribution as Newfoundland to New England and New York and northern Minnesota. This juniper is entirely out of its range. There are a couple dozen clumps on a clay hillside with a north exposure. Lime creek is about a quarter of a mile away to the north. The associated plants are interesting: the western woolly thistle (*Cirsium canescens*), the most eastern locality in Iowa; also *Petalostemum violaceum, Astragalus canadensis, Panicum virgatum* and *Phlox pilosa*.

The structure of some nectar glands of Iowa honey plants: WILLIAM S. COOK.

Geology

An excellent example of high clay bank erosion in Lee county, Iowa: BEN H. WILSON.

White clay in Clinton and Jackson counties: S. L. GALPIN.

Fossil Annelid jaws from the Devonian of Iowa: WALTER V. SEARIGHT.

The occurrence of a black bituminous shale near Palo, Linn county: GLENN S. DILLE.

An unusual well record in northwestern Iowa: JAMES H. LEES. The well recently drilled for the town of Holstein is remarkable in showing in its lower part, beneath the St. Peter sandstone and the Prairie du Chien limestone, a rather thin series of shales with an intercalated sandstone layer, which probably represents the great Cambrian sandstones of the Mississippi valley. Below these is about forty feet of somewhat quartzitic sandstone, a part of which is very red. This may correspond to the thick body of the Sioux quartzite, which is exposed less than a hundred miles to the northwest. Beneath this bed is a pink hard granite, which was penetrated for thirty feet. The total depth of the well is 2,040 feet, from a curb altitude of 1,439 feet.

Lake Huron winter beach forms: MAX LITTLEFIELD. Accumulations of pebbles and cobbles piled on a Lake Huron beach by wave action in re-entrants of the fringing shore ice.

Phosphate in Iowa limestones: JOHN E. SMITH.

Experiences of a well digger: JOHN M. LINDLY.

The geographic distribution of Iowa Devonian echinoderms: A. O. THOMAS. Distribution of species is practically limited to the confines of the state and a given species seldom ranges through more than one formation. The genera in most cases have considerable geographic range, being found not only in the Devonian of neighboring states but some of them in more remote parts of the continent. *Arthracantha* and *Agelacrinus* are examples of the latter, while *Dactylocrinus* and *Xenocidaris* are found in the Devonian of Europe.

Some giant Stromatopora from near Iowa City, Iowa: A. O. THOMAS. A recently opened quarry in the Cedar Valley limestone has been the source of colonies of Stromatopora over a foot in diameter. They are of the multilamellar type common in the Iowa Devonian, but hitherto represented in this locality by individuals only a few inches in diameter.

Fossils from an outcrop in Des Moines, Iowa: A. O. THOMAS. The pit of the Capitol City Clay Company is typical of several highly fossiliferous exposures of the Henrietta beds in Des Moines and vicinity. Brief descriptions and illustrations of the commoner species, it is hoped, will stimulate local students and collectors.

The eruption of Mt. Tarawera, New Zealand: A. O. THOMAS. A visit was made by the writer in July, 1922, to the area covered by the ejectamenta of the 1886 eruption. The debris of that eruption was spread over an area close to 6,000 square miles. About one fourth of this area was thereby rendered unsuitable for agriculture. Except in the immediate vicinity of the mountain, natural and artificial re-forestation have quite reclaimed the region. Near the south end of the Tarawera rift violent mud eruptions have occurred within the last five years. Observations on the geysers at Waimangu and Rotorua also are noted.

Numerical limitations to glacial epochs: CHARLES KEYES. The five glacial till sheets which Iowa presents

critically demonstrate a periodic phenomenon that doubtless has some cosmical cycle for basis. Beginning with the Nebraskan till which extends farthest south in Kansas and Missouri, later tills are successively less extensive. This circumstance suggests that if there were successive retrogression, there should also be successive progression, until a maximum extension was reached in the Nebraskan till. In recent deep excavations in Des Moines under the ancient, south-facing bluff of the Raccoon River, where traces of such old tills would be most likely to occur and be protected, there appear to be remnants of at least two tills older than the Kansan drift which overlies them. Pre-Kansan tills need careful scrutiny with the idea in mind of a possible multiple nature.

Stratigraphic position of Sweetland black shales: CHARLES KEYES. When the black shales of Louisa County were first described and designated the Sweetland Formation there was ascribed a Devonian age to them. Since the appearance of the report these shales were more properly correlated with the black shales occurring farther south in Missouri, best assigned to the Carboniferous period. Recently a new interest is awakened in this formation. It has to be considered in its relations with similar shales now known to extend to the eastward to Ohio, and southeastward to Alabama. Through all this wide range there are many names attached and the new problem has to do with the adjustment of them in no less than nine states.

Water table of the loess: CHARLES KEYES. Writers on the loess frequently note the presence of curious ferruginous bands, two or three inches in thickness, traversing the deposits obliquely. So far as he is aware no one alludes to their possible cause. In certain extensive street grading in Des Moines a short time ago these "iron bands" were unusually well developed. They were plainly subparallel to the present surface of the ground and about eight feet down. They passed at this depth from the Wisconsin till above, through the loess bed in the middle, into the Kansan drift beneath. These bands manifestly marked the position of the old groundwater level before the hills were tapped by various excavations and the ground waters lowered or drained off. Old wells long since filled up and forgotten in the growth of the city but unearthed by the recent cuttings all go down to this old iron band.

Apparent fossil fruits from the Fort Union beds: M. A. STAINBROOK.

Chemistry

Iowa Section, American Chemical Society

An interesting deposit of lime: F. C. STANLEY.

Electrometric titration of chlorate, bromate, iodate with titanous ion: W. S. HENDRIXSON and N. L. CRONE. These substances may be thus directly determined, and the voltage curves show that the reduction takes place in two phases.

The incomplete oxidation of sulfite by dichromate: W. S. HENDRIXSON and P. W. HUSH. The dichromate reduced was four per cent. too low, probably due to formation of dithionate as in the action of sulfurous acid on permanganate.

The decomposition of double salts: NICHOLAS KNIGHT.

Substances dissolved in rain and snow: H. S. FRIES and NICHOLAS KNIGHT. A continuation of the work on the various substances dissolved in rain and snow. Forty-one samples of rain and snow were collected and analyzed from September 19, 1921, to June 2, 1922, inclusive. There was a total precipitation equivalent to 17.46 inches of rain, calling 12 inches of snow equal to an inch of rain. It was found that the precipitation of the latter part of October and the latter part of April happened to be identical. The nitrogen in nitrates and nitrites, free and albuminoid ammonia, chlorides and sulphates were determined.

Concerning the action of urease: E. W. ROCKWOOD.

The reaction of nitrogen trichloride with some unsaturated hydrocarbons: G. H. COLEMAN and ELIZABETH PICKERING.

Further observations and summary of results obtained in the study of the migration of acyl from nitrogen to oxygen: L. CHARLES RAIFORD.

(a) *Methods of acylation and effect of relative weights of acyl radicals:* J. R. COUTURE.

(b) *Effect of relative positions of amino and Hydroxyl Groups:* E. P. CLARK.

(c) *Effect of acidity of acyls:* H. P. LANKELMA.

(d) *Behavior of bases derived from condensed nuclei:* J. C. COLBERT.

Studies in orientation, I.: L. CHAS. RAIFORD and C. CARROLL HILMAN.

A study of the equilibrium between iodine and barium iodide in aqueous solution: J. N. PEARCE and W. G. EVERSOLE.

A study of the equilibrium between bromine and strontium bromide in aqueous solution: J. N. PEARCE and J. V. O'LEARY.

Further work on the equivalence of the activity of the halide ions: J. N. PEARCE and A. R. FORTSCH.

A sensitive test for copper in the electrolytic determination of copper: STEPHEN POPOFF and C. W. TUCKER.

Critical study of standardization of solutions used in iodimetry: STEPHEN POPOFF and J. H. WHITMAN.

The electrometric titration of tin: STEPHEN POPOFF and F. L. CHAMBERS.

A solubility survey—solubilities in sulfur dioxide.

III. *Solubilities in the 5th series of the periodic system at 25° C.:* I. C. BROWN and P. A. BOND.

IV. *Solubilities in the 8th series of the periodic system at 25° C.:* S. H. BOBROV and P. A. BOND.

V. *Solubilities in the 4th series of the periodic system at 25° C.:* F. W. PERISHO and P. A. BOND.

Notes on the mechanism of methylation reactions: HARRY F. LEWIS, SHERMAN SHAFFER and RUSSELL MORGAN.

The tetraalkylthiuramdisulphides: HARRY F. LEWIS and SHERMAN SHAFFER.

Synthetic hypnotics in the barbituric acid series: ARTHUR W. DOX.

The effect of impurities on the physical properties of oxychloride cements: BEN H. PETERSON.

JAMES H. LEES,
Secretary

SCIENCE

VOL. LVIII AUGUST 31, 1923 No. 1496

CONTENTS

SCIENCE: A Weekly Journal devoted to the Advancement of Science, edited by J. McKeen Cattell and published every Friday by

THE SCIENCE PRESS

Lancaster, Pa. Garrison, N. Y.

New York City: Grand Central Terminal.

Annual Subscription, $6.00. Single Copies, 15 Cts.

SCIENCE is the official organ of the American Association for the Advancement of Science. Information regarding membership in the association may be secured from the office of the permanent secretary, in the Smithsonian Institution Building, Washington, D. C.

Entered as second-class matter July 18, 1923, at the Post Office at Lancaster, Pa., under the Act of March 3, 1879.

ABSOLUTE MEASUREMENTS OF SOUND[1]

IT is now more than thirty years since it occurred to me to devise an instrument that should be capable of measuring the intensity or loudness of any sound at any point in space, should be self-contained and portable, and should give its indications in absolute measure. By this is meant that the units should be such as do not depend on time, place, or the instrument, so that, though the instrument be destroyed and the observer dead, if his writings were preserved another instrument could be constructed from the specifications and the same sound reproduced a hundred or a thousand years later. The difficulty comes from the fact that the forces and amounts of energy involved in connection even with very loud sounds are extremely small, as may be gathered from the statement that it would take approximately ten million cornets playing *fortissimo* to emit one horse-power of sound.

Before we can measure anything we must have a constant standard. In sound we must construct a standard which emits a sound of the simplest possible character, which we call a pure tone; it will be like that emitted under proper conditions by a tuning-fork, which is described by saying that the graph representing the change of pressure with the time shall be that simple curve known as the sinusoid or curve of sines. From this connection we say that the pressure is a harmonic function of the time. Unfortunately the pressure change is so small that at no point in a room, even when a person is speaking in a loud tone, does the pressure vary from the atmospheric pressure by more than a few millionths of an atmosphere. Thus we require a manometer millions of times as sensitive as an ordinary barometer, and, in addition, since the rhythmic changes occur, not once in an hour or day, but hundreds of times per second, if we wish the gauge to follow the rapid changes accurately, we have many mechanical difficulties.

The problem of a standard of emission has been solved by a number of persons, including Professor Ernst Mach and Professor Ludwig Boltzmann, and Dr. A. Zernov, of Petrograd, a pupil of the celebrated Peter Lebedeff. The problem of an absolute instrument for the reception and measurement of a pure

[1] An address before the Royal Institution of Great Britain, June 10, 1921, by the late Arthur Gordon Webster, D.Sc., LL.D., Hon.M.R.I., Professor of Physics, Clark University.

tone has been also successfully dealt with by a number of investigators, among whom may be mentioned Professor Max Wien, of wireless fame, the late Lord Rayleigh, and Lebedeff. But there remains a third step in the process, which is as important as the first and second. Given the invention of the proper standard source of sound, which I have named the "phone," because it is *vox et praeterea nihil,* and of a proper measuring instrument, which should evidently be called a phonometer, there still remains the question of the distribution of the sound in space between the phone and the phonometer. Any measurements made in an enclosed space will be influenced by reflections from the walls, and, even if we had a room of perfectly simple geometrical form, say cubical, and were able to make the instruments of emission and reception work automatically without the disturbing presence of an observer, it would still be impossible to specify the reflecting power of the walls without a great amount of experimentation and complicated theory. Nevertheless, this is exactly what was done by the late Professor Wallace C. Sabine, of Harvard University, who employed the human ear as the receiving instrument. Those who have made experiments upon the sensitiveness of the human ear for a standard sound will immediately doubt the possibility of making precise measurements by the same ear at different times, and particularly of comparing measurements made by one ear with those made by another. Nevertheless, Sabine attained wonderful success, and was able to impart his method to pupils who carried on his work successfully, so that he was able to create the science of architectural acoustics and to introduce a new profession. Still, the skill that required three or four months to attain by Sabine's method may be replaced by a few minutes' work with the phonometer.

In order to avoid the influence of disturbing objects, the observer should take the phonometer to an infinite distance, which is manifestly impossible. The method employed was to get rid of all objects, except a reflecting plane covered with a surface the coefficient of reflection of which could be measured. For this purpose the teeing ground of a suitable golf course was used. With the present instrument it can be determined in a few minutes, if there is no wind.

In 1890 I proposed to use a diaphragm made of paper, which should be placed, shielded on one side, at the point where the sound was to be measured. In order that the effect of the sound should not be distorted, the membrane, instead of having to do any work, as in the case of the diaphragm of the phonograph in digging up the wax, or in that of the microphone in compressing the carbon, was to be perfectly free, but was to carry a small plane mirror cemented on at its center. In close juxtaposition and parallel with this was the plane side of a lens which, viewed in the light from a sodium flame, was to give Newton's rings or interference fringes. Of course, when the sound falls upon the diaphragm the fringes vibrate rapidly and disappear from sight.

By the introduction of a Michelson optical interferometer, two of the difficulties of this instrument were overcome—namely, (1) that of adjusting the lens so that it would not strike the vibrating mirror, since the mirrors in the interferometer could be as far apart as one pleased; and (2), more important still, it permitted the use of fringes in white light, so that it was possible to use gas, incandescent, or arc light with excellent effect. A further improvement was introduced by the use of a thin plate of mica for the diaphragm.

To obtain the sensitiveness necessary to measure sounds of ordinary intensity, the property of resonance is employed twice—*i.e.*, a system of two degrees of freedom is used. First, the plate resounds to a sound more strongly as it is tuned more nearly to it; and second, a resonator that can also be tuned is put behind the plate. The sound entering by the hole in the resonator is magnified by the tuning, and acts upon the plate, which is also tuned. A graph can be plotted in which one coordinate represents the stiffness of the plate, or rather what may be called the mistuning, which is the stiffness lessened by the product of the mass by the square of the frequency. The other coordinate represents the corresponding quantity for the resonator, the stiffness of which depends simply on the volume into which the air is compressed, while the effective mass depends on the dimensions of the whole, and its damping on the sound radiated from the mouth. It is then found that the tuning should not be such as to make the representative point occur at the middle of the figure, making both mistunings zero, but that both mistunings should be of the same sign and a certain magnitude, depending on the coefficients of damping of the two degrees of freedom of the coupled system. The mathematical theory is precisely that of a wireless receiver. The ultimate sensitiveness depends on the smallness of the damping of the plate.

The apparatus as it was built several years ago was mounted upon a heavy bronze stand, covered at the back by a heavy bronze cover to keep out the sound, while the three shafts turning the screws of the interferometer adjustment protruded through sound-tight fittings. Upon the front of the instrument a properly tuned resonator was attached, and at the side was a small incandescent lamp with a straight, horizontal filament, an image of which was projected by a lens upon the first mirror of the interferometer. Upon this was focused a telescope, giving in the reticule an image of the horizontal, straight filament, crossed by

the vertical interference fringes seen with white light. In order to get these the plate must be in the proper position within a few hundred-thousandths of an inch. The objective of the tuning-fork was carried by a tuning-fork which oscillated vertically, tuned to the pitch of the pure tone to be examined, and this, combined with the horizontal motion of the fringes, resulted in a figure of colored fringes in the form of an ellipse. On slightly mistuning the fork, the ellipse could be made to go through all its phases, and when it was reduced to an inclined straight line its inclination was read off on a tangent scale. The amplitude of the compression of the air in the sound was then directly proportional to the scale-reading.

While the interferometer is still used for calibration, the movement of the diaphragm is recorded for actual measurements by a thin steel torsion strip carrying a concave mirror. A lamp with a vertical, straight filament is viewed through a telescope into which the small mirror focuses the image of the filament on the reticule, and a magnification of from 1,200 to 1,500 is used, so that the sensitiveness is about the same as with the interferometer.

At first the only method of tuning was the clumsy one of changing the mass of the diaphragm by adding small pieces of wax. This was not capable of continuous variation. Now the diaphragm has been discarded and replaced by a rigid disc supported by three steel wires in tension. The disc is made of mica or aluminium, and is carried by a little steel spider containing three clamps to hold the wire. The tension is regulated by three steel pegs, one of which is controlled by a micrometer screw. The disc is placed in the circular hole through which the sound enters the resonator. This has the advantage of reducing damping very largely, and thus of increasing the sensitiveness enormously. The instrument now competes with the human ear, and can be tuned over two octaves or more.

This sensitiveness can be demonstrated by projecting the colored interference fringes on a screen and singing faintly in a remote part of the room, when the fringes will disappear. Using the telescope end of the apparatus, the instrument will indicate the sound of a tuning-fork when one can scarcely hear it. It is obvious that the disc may be made the diaphragm of a telephone and thus increase its sensitiveness. In fact, Professor King has used such a telephone to record wireless messages with great success. He has also invented another sort of tunable diaphragm composed of a stretched steel membrane with compressed air behind it, which enables it to be tuned continuously, but over a smaller range.

I now come to the source of sound—the phone. This has been reduced to a reversed form of the phonometer. The disc is driven by an interrupted or alternating current by means of electromagnets, and tuned like the phonometer. Its excursion is measured by a powerful microscope, and the emission of sound is known in absolute measure. It is now driven by a triode valve tube, in the manner suggested by Professor W. H. Eccles, of Finsbury Technical College, London, for a tuning-fork. This has been worked out for me by Dr. Eckhardt at the Bureau of Standards in Washington.

The third part of the investigation involves a determination of the coefficient of reflection of the ground. The phone is set at a convenient height, and the phonometer at a convenient distance. Either is then moved along at a constant height and the varying deflections of the phonometer are read while the sound remains the same. Interference sets in between the direct sound and its image reflected in the ground, and the existence of a minimum is obvious to the most naïve observer by the ear alone. The reflection of either grass or gravel was found to be about 95 per cent., while, with a most carefully deadened room, the walls of which were covered with thick felt, there was perhaps 20 per cent. reflection. The whole measurement at both ends and the transmission checks up with an accuracy of about 2 per cent.

With this apparatus all sorts of acoustical experiments may be performed. By attaching to the phonometer a long glass tube or antenna, it has been possible to explore all sorts of places, such as the field within a horn or tube lined with an absorbent substance. The transmission of sound through fabrics, walls and telephone booths may also be quickly examined. The instrument is used by psychologists and by telephone and acoustic engineers, and is of interest to navigators. An interesting by-product is an instrument for showing the direction of an acoustic signal in the fog. It has been called a phonotrope, on the analogy of heliotrope, which turns to the sun. It consists of two equal horns which bring the sound to the opposite sides of the disc. When the whistle blows, the band of light spreads out, and on turning the instrument it closes to zero when the sound is directly ahead. Thus at several miles the direction is given to within two or three degrees.

Finally, let us consider that mystery of sound, the violin, which has been studied by Professor Barton, of Nottingham, and Professor Raman, at Calcutta. This may be described by the engineer as a box of curious shape, made of a curious substance, wood, of variable thickness, with two holes of strange figure to let the sound out of the resonating box. The latter is actuated by a curious substance, catgut, made of the intestines of a sheep, and set in vibration by another curious substance, the tail of a horse. Yet from this wonderful box we get the most ravishing sounds, which affect profoundly the emotions of the most

civilized. Yet the physicist reduces all musical instruments to combinations of resonators with strings, membranes, bars, plates and horns. The mathematical theory of strings was given by Euler two hundred years ago, of bars and plates less than a hundred years, of resonators by Helmholtz and Rayleigh, and I have recently added a theory of horns which, while only approximate, works well in practice, and investigations are now being carried out by such methods on vowels and the violin.

ARTHUR GORDON WEBSTER

SCIENCE AND PHILOSOPHY IN VIRGIL

RELIGIOUS superstition once borrowed such a large portion from the works of Virgil, though it was accomplished in a way as inexplicable as it was unwarranted, that we are apt, from the standpoint of science, to dismiss him altogether as a source from which to gather anything useful in the history of scientific thought. It is no wonder, however, that the ardent early fathers of the Christian church found in the fourth Eclogue an indication, pregnant with prophecy, conscious or unconscious on the part of the poet, of the coming of Christ and the regeneration of the world, a return to its golden age. Other interpretations have of course been made of the lines, but the ready credulity of a budding faith had every temptation to accede to the conviction that Virgil was a herald of the approaching light of the world. But the reputation Virgil had in the Middle Ages partook of that of a man of science. He was a wizard, the happy man who knew the causes of things,

> Felix qui potuit rerum cognoscere causas.[1]
> How blest the sage! whose soul can pierce each cause
> Of changeful Nature, and her wondrous laws.

As a matter of fact this was no boast of Virgil, it was only his sigh that he did not understand them all and it is difficult to see, in spite of Comparetti's monumental work,[2] what could have given the mind of the middle ages that respect for Virgil as a man of science, of which we find so many traces in the authors of the pre-Renaissance. For them he was not so much the necromancer of verse, recognized by a later and an earlier age, as a wizard of knowledge in natural science. The lines however which precede[3] the one above, so often quoted, give us a glimpse of the kind of things he had in mind when he longed for a knowledge of their causes.

> The muses [he declares] . . . will show me the paths of heaven and the stars, the various eclipses of the sun and the changes of the moon, whence comes the quaking in the earth, by what force the sea swells high on the rocky shores and again sinks back upon itself, why the winter sun rushes on to plunge beneath the ocean wave, what it is lengthens out the tedious nights, but if I could not draw nigh to these parts of Nature the cold blood would gather round my heart.

That is, as I take it, for Sotheby certainly goes astray here, if he could not imagine some rational explanation of these things he would stand terror stricken in the presence of God. That is the reason, it seems to me, he exclaims, "fortunate indeed is he who perceives the causes of things."

In Virgil, as in all ancient writers, we get a far franker acceptation than we do to-day, a much plainer indication of the all pervading pantheism in the fundamental beliefs of men. It is probably as widespread to-day, but it is hidden beneath a reticence which the mystic faith of Christ, quite in contrast to the ancient pagan tendencies, imposes on its communicants. Still it peeps out now and then, not in science alone where it has the support of physics, but in religious pedagogy with the maxim that God is everywhere. The haruspices and the augurs thought or, in Virgil's day, pretended to think that the birds bore the impress of the will of the gods on their in-

[1] Georgicon II. 490. I use Sotheby's translation here, but the classics are immortal because they have a message for each generation, otherwise they would have perished. Only from the text can the modern critic judge if the references from it are valid for the scientific thought of this generation. There can be no doubt Virgil is here referring to Lucretius whose De Rerum Natura was his model in youth.

[2] Virgilio Nel Medio Evo, per Domenico Comparetti, Fierenze, 1896.

[3] Me vero primum dulces ante omnia Musae,
quarum sacra fero ingenti percussus amore,
accipiant caelique vias et sidera monstrent,
defectus solis varios lunaeque labores;
unde tremor terris, qua vi maria alta tumescant
obicibus ruptis rursusque in se ipsa residant,
quid tantum Oceano properent se tinguere soles
hiberni, vel quae tardis mora noctibus obstet,
sin has ne possim naturae accedere partis
frigidus obstiterit circum praecordia sanguis:

But, most beloved, ye Muses! at whose fane
Tranced by deep zeal I consecrate my strain,
Me first accept! and to my search unfold
Heaven and her host in beautious order roll'd;
Th' eclipse that dims the golden orb of day,
And the moon labouring through her changeful way;
Whence rocks the earth, by what vast force the main
Now bursts its barriers, now subsides again;
Why wintry suns in ocean swiftly fade,
Or what delays night's slow-descending shade.
But if chill blood, long lingering in my vein,
From Nature's secret lore my search restrain,

ternal viscera and in their actions manifested an understanding of it in preparing for future events. Now Virgil disdained such supercheries, patching out the superstitions of the time when they were universal, for use at a time when they were employed only to sway the minds oppressed by ignorance and credulity. He concluded that it was the rarefaction and condensation of the atmosphere which agitated the bodies of twittering birds and bellowing cattle,

et laetae pecudes et ovantes gutture corvi.

It was the "Jupiter Uvidus" who rarefied the air and condensed it, so no reverence was lost. When the winds of heaven blew the ethereal disturbance was conveyed to the minds of men, the subtle pneuma gliding past their hearts, and governed the flights of the birds of the air[4] and the tossing heads of the beasts of the field. We are unable still to add much to this except our indifferent skepticism, but we should remember we have as yet hardly lifted a corner of the veil of the ignorance which prevails in modern science as to the atmospheric influences exerted on living beings. We know nothing of the changes in the psychical state by virtue of which the animal does this or that. We put them all down to heat and cold, "dense and rare" and Virgil did as much.

Virgil's pantheism was the pantheism of his day and that it filled the air all around him we can see in his youthful poem, the Culex. The whole theme is the feeling of the gifted boy that the poor gnat which he destroyed at a blow was a possessor like himself of a shred of the soul of the Infinite. It was the sting of the insect which was the interference of God and it saved the sleeping shepherd, in whose name Virgil sings, from the venom of a spotted snake. This philosophy Virgil found in his youth and it dwelt with him through life, but it in no way distinguished him from his contemporaries, however well it fitted in with the beliefs of Dante's time. It is seen in the work of his earlier manhood in the way he speaks in his bucolics[5] of the bees and the phenomena they exhibit as an evidence of the workings of the universal mind. I believe we call it instinct now, though perhaps there has been little left of that term in the recent overturn in biology. We find the mystic theory at the maturity of his marvelous powers in the Aeneid[6] where the hero, visiting his father in Hades, learns from him the nature of creation, how even in the beginning, Anchises says, "heaven and earth and the flowing fields of the sea and the blazing sun, the moon and the Titanian stars are animated by the spirit within them." Unless we keep before us this saturation of the ancient mind with this philosophy, far beyond the point of our own vague thoughts, we will find it difficult to understand how so many, indeed nearly all, clear minds of antiquity adopted vitalistic doctrines as a part of their science. Even Aristotle, deeply analytical as was his mind, saw no skulking, no begging the question in his use of the "entelechy."

However, as we have seen, even Virgil's poetic mind had a touch of practical materialism and he placed the density and the rarefaction of the air in between the cawing of crows and the divine mind. As it was these which explained for him the state of the weather and the fluttering of the birds, so it is the rarity and compactness of the soil which tells the farmer whether the field is adapted to grape growing or wheat culture. The same words—densa and rara—are used for the soil as for the air.[7] But there is something more to be learned from an examination of the soil than this and it is by a method curiously in accord with a part of the modern technique of soil analysis, rudimentary though it is. There is a touch of his wonderful art in its description which I will not attempt to give. A salt and bitter earth is bad for fruits and it is not helped by plowing. To make a test of the condition, put the bad soil carefully ground up into a basket or sieve and through it filter sweet water from the spring. As the drops of water emerge on the wicker work of the primitive filter their quality may be tested by the tongue. The acidity or the alkalinity of the soil is thus betrayed to one of the senses, that of taste, instead of by the visible reactions of the modern test tube. The richness, the "fatness of the soil," betrays itself to the sense of touch as it is exercised between the fingers when it is finely pulverized. Such beginnings then as were possible for scientific endeavor Virgil records and his theory of atmospheric pressure was singularly near the results obtained by the barometer as to the processes of nature which precede atmospheric disturbances more evident then than now to the unaided senses.

JONATHAN WRIGHT

PLEASANTVILLE, NEW YORK

[4] Georgicon I. 417–422.

[5] Georgicon IIII. 219–222.

[6] Aeneis VI. 724 seq.

[7] Georgicon II. 226–228.

TRANSITION ZONES

THE thesis here presented is that the indefinite territory existing between two faunal areas should be considered primarily as a transition zone, not as a unit faunal area or sub-area.

A faunal area may be defined as an area characterized by certain animals and thus differentiated from other faunal areas characterized by other animals. The arctic, temperate and tropic zones are so characterized and may be treated as primary faunal

areas and their subdivisions again as secondary faunal areas. This concept is a very useful one and works out especially prettily in mountainous regions where high altitudes give the same like conditions as high latitudes and are associated with the same forms of life. In America, high latitude conditions and high latitude birds, for instance, follow the mountain ranges towards the equator, a fact that is brought out prettily in a map showing the tongues and islands of high latitude life near the mountain tops and bands of temperate life below on the mountain side.

The first point that the writer desires to make here is that, however interesting it is to plot such latitude-altitude zones in a mountainous country, they do not necessarily constitute sound faunal areas or units in problems of zoogeography. The reason is simple enough, for they are based almost entirely on temperature, whereas precipitation and topography are equally important factors in determining the kinds and dispersal of life. With these three determining factors working variously together or opposed, it is not a theoretical necessity that large faunal areas can be predicated and subdivided in any system that will be a matter of fact rather than a matter of opinion. It so happens, however, that they can be.

Take now the United States and Canada. It would seem to the writer that the primary faunal areas in this region are three; Canadian, Carolinian and Western; Canadian and Carolinian based on latitude, their boundaries modified by altitude; the Western sharply separated from the Carolinian to the east by the precipitation factor and less sharply from the Canadian to the northeast by the topography factor. Canadian and Carolinian areas are uniform with uniform faunas. The Western area, due to its topographic variety and resultant temperature and precipitation variation, is exceedingly varied and may be advantageously divided into minor areas, as has been done.

In the East, the Canadian to the north, and the Carolinian to the south are uniform faunal areas, but between the two lies an irregular transition zone of varying width (as here understood more or less synonymous with the "Transition Zone" of current latitude-altitude zonal divisions of mammals and birds). The ordinary climatic controls seem here to be subordinated to various minor topographic influences which are hard to predicate. For instance, of two related birds of the genus *Vermivora*, near the Atlantic coast, one, *V. chrysoptera*, breeds in broken transition country to the north; the other, *V. pinus*, southerly in the coastal plain edge of the Carolinian; whereas, going to western Pennsylvania, *V. chrysoptera* breeds in typical Carolinian broken country and *V. pinus* north of it in less broken country. This transition zone is not entirely an intermingling of Canadian and Carolinian forms. In birds, for instance, certain forms are peculiarly characteristic of it. Endemic forms in a transition zone, however, do not make it a faunal area. It is, and should be considered as, a transition zone between faunal areas.

A transition zone which has considerably influenced the writer's viewpoint on this problem is one affecting marine, not land, animals. Off the Atlantic coast of our middle states the Continental Shelf extends out some miles with depths increasing gradually. Then, at about 50 fathoms, it rounds off abruptly into the deep sea. As regards fish life, the inshore waters are here the meeting place of two definite shore faunas, a northern North Atlantic, and a southern American coastal faunal area (with species of shore fishes which differ from the shore fishes of Europe or elsewhere). The deep sea beyond the edge of the Continental Shelf harbors fishes of an entirely different sort and should be considered as a deep sea faunal area. The catch brought up by a beam-trawler from 65 fathoms or somewhat more on the slope from the Continental Shelf into the deep may comprise certain species, notably the spined dogfish, and likely *Poronotus*, the sea robin, in late fall, characteristic of the shore area. With them may come the bright red, grotesque *Peristedion* or deep-water sea robin, obviously from the adjacent deep-sea area. There will also be certain species endemic to this narrow strip of sloping bottom, namely, the tilefish, *Zenopsis* (allied to the John Dory of Europe) and *Catulus retifer* (related to the European dogfish). All three are shore derivatives rather than deep-sea derivatives, but, strangely enough, not represented in the faunal areas of shore fishes adjacent. Dory and dogfish represent the southern European shore fauna, and the tilefish perhaps has its nearest shore relatives in the Blanquillos of the Pacific coast. Why are these fish present in this transition zone? One viewpoint only seems to explain it—that between the shore fauna inside and the deep water fauna outside is in some way a favorable locality for foreign species to gain a foothold. With this in mind, we have the following hypothesis concerning transition zones—that they are lines of weakness which representatives of outside faunas may penetrate and where they may establish themselves.

To return to the land faunas of America. Is there any indication of such penetration in the transition zones between the faunal areas postulated? There are certain things which may be so interpreted. It will be noted that the prairie chicken from the west reached the Atlantic coast in a transition latitude and established a race on Martha's Vineyard. Further north or further south it must have penetrated through country more strongly held by the ruffed grouse on the one hand or the bobwhite on the other.

Eastward extension of prairie forms in the latitude of the transition zone south of the Great Lakes is a phenomenon in line with this hypothesis. Also, certain eastern birds cross the prairies and penetrate surprising distances to the northwest in the ill-defined and broken transition zone there existent between the western and Canadian faunal areas, a notable example being the eastern kingbird, which breeds at least in eastern Washington. The prairie area of the Mississippi Valley (as differentiated from the dry plains area west of it) is a transition zone between the east, with sufficient, and the west, with insufficient, rainfall. In the main, its bird fauna is either eastern or western, but it does not lack species almost exclusively confined to it, such as Bell's vireo, a summer resident, or Harris's sparrow, as a transient species.

In conclusion, the writer wishes to point out his concept that between two faunal areas there is normally a transition zone. To consider this also as a faunal area and use it as a unit in zoographical discussions can lead only to complication and confusion. Looked at as what it is, a separate phenomenon, it will repay analysis and study.

J. T. NICHOLS

THE AMERICAN MUSEUM
OF NATURAL HISTORY

THE INTERNATIONAL CRITICAL TABLES

THE Board of Editors of International Critical Tables met in Washington, D. C., for a three-day session beginning on August 16 for the purpose of selecting the cooperating experts who will be invited to assume responsibility for critically compiling the various classes of data to be included in the tables. It is estimated that some three or four hundred cooperating experts will be needed and the selection will be made largely on the basis of recommendations received from the corresponding editors and their advisory committees from the principal countries of the world. Several sessions of the board will be required before the complete list can be made up. Invitations to act in the capacity of cooperating experts will be issued from the editorial office as fast as action is taken by the board and, from the responses thus far received, a full measure of cooperation is expected from the chemists and physicists of the world in making this undertaking a success. In dividing the subject-matter for purposes of assignment to the cooperating experts, the editorial board has endeavored to make each assignment of such a magnitude that it can be reasonably completed in a year's time without proving too great a burden upon any expert and if each one associated with the work will cheerfully accept and carry out his share and responsibility, the combined result of the labors of all who cooperate in the work will be invaluable to science and industry.

The scope of the work is so great and the fields to be covered so varied in character that only through the joint labors of a large number of experts will it be possible to bring the undertaking to a successful conclusion in a reasonable time. The International *Annual* Tables is now in its twelfth year. It has demonstrated the possibility of preparing through international cooperation an annual abstract of the results of the world's researches in quantitative measurement. The purpose of International *Critical* Tables is to take an account of stock of our present quantitative knowledge of material things and to publish in convenient form the result of expert criticism of this knowledge. The practicability of further effective international cooperation on scientific projects will doubtless be judged largely by the degree of success obtained in these efforts.

The International Union of Pure and Applied Chemistry and the International Research Council have given the weight of their authority and influence to International Critical Tables. American industries will supply the necessary funds. It remains only for the scientists of the world to contribute their time, energy and expert knowledge to insure the successful completion of the undertaking. Science itself is international. The preparation of the record of scientific achievement in quantitative measurement should also be international. If the results of scientific research are to be utilized most efficiently, they must first be made easily accessible. To make these results accessible so that they may be utilized to the best advantage is as much the duty of men of science as are the researches which produce them, and the task of rendering these results readily accessible requires the cooperation of the same types of expert knowledge as have been employed in producing them.

As rapidly as appointments of cooperating experts are made and accepted, announcement thereof will be made in the scientific and technical press.

The organization of International Critical Tables is as follows:

Saul Dushman,
John Johnston,
C. E. K. Mees,
C. E. Mendenhall,
R. B. Moore.

Associate Editors and Special Editors:
Joseph Pelc, Special Tables of Organic and Inorganic Substances.
F. R. Bichowsky, Thermochemical Data.
Walter Rosenhain, Metals and Alloys.

SCIENTIFIC EVENTS

THE PULPWOOD RESOURCES OF CANADA

A ROYAL commission to investigate Canada's pulpwood resources and the advisability of prohibiting the export of this product has been appointed by the Canadian Government. The commission is headed by Joseph Picard, Quebec, a manufacturer and business man, and includes in its personnel two lawyers, one lumberman and one contractor. Instructions have been issued to the commission to inquire into the report upon the forest resources, with particular regard to the extent in each province of woods of various kinds available for the manufacture of pulp. Other directions to the commission follow:

1. To inquire into the quantity of pulp available, owned by the provincial governments and subject under provincial laws and regulations to restrictions requiring the partial or total manufacture of such wood in Canada.

2. To inquire into the quantity of wood so available on lands owned by the Canadian Government and subject under federal laws and regulations to restrictions requiring partial or total manufacture in Canada.

3. The quantity of wood on other lands and the conditions under which such lands are held, whether by ownership or lease, whether by corporations or individuals, whether by citizens of Canada or citizens of other countries.

4. The quantity of pulpwood produced in each province during the past ten years, showing the portion used in Canada and the portion exported.

5. To investigate the question of the restriction of the export of pulpwood from Canada, and any other matter touching upon the production, manufacture or sale of pulpwood essential to a comprehensive consideration of the question of the restriction of export.

The commission is to make recommendations that may be deemed expedient for the better conservation of the supply of pulpwood for present and future use. The pulpwood investigation was promised at the last session of Parliament, when the Government was given power to prohibit the export of pulpwood at that time. The Minister of Finance promised that the Government would not exercise its authority in this respect until after a searching review of the whole situation.

Chemical and Metallurgical Engineering states that the situation brought about by the proposed embargo "has given rise to much speculation as to Canada's ability to continue supplying the United States with pulpwood. It is estimated that Canada has 250,000,000 acres of forest growth of merchantable size, and 600,000,000 forested acres of young timber suitable for pulpwood. It is assumed that the 600,000,000 forested acres of young timber would yield 1,250,000,000 cords of pulpwood. The present consumption is 4,000,000 cords per annum. On that basis the supply would last for over 300 years, without allowing for from two to three per cent. of regrowth; but at that point the authorities differ. It is stoutly maintained by some experts that Canada has not as much pulpwood in sight as is supposed, and that on the basis of consumption during the past twenty years in particular, the resources would be exhausted in 60 years, or reduced to a volume which would mean exceedingly high cost for pulp."

THE FOSSIL FIELD IN MONGOLIA

THE Peking correspondent of the London *Times* writes that the researches of Mr. Roy Chapman Andrews, who for some years has been exploring the less-known regions of China and adjacent territory in the interest of the Natural History Museum of New York, are likely to add considerably to scientific understanding of prehistoric times.

Mr. Andrews concludes that Mongolia is one of the greatest fossil fields in the world, and his discoveries in this respect go far to confirm the theory that Central Asia was the center of the dispersal of the mammalian life of Europe and America. He says that the existence of a land connection between Asia and North America has been unquestionably established.

With reference to the work of the Third Asiatic Expedition under his leadership, now busy in the Gobi Desert at a point about four hundred miles northwest of Peking, Mr. Andrews says:

> The first month of the expedition's work is far beyond our hopes. Where we expected only fragments we have discovered an immense deposit of large and small dinosaur bones. It will require many months to exhaust this region, but we have removed two partially complete skeletons and parts of several others. This includes herbivorous dinosaurs 30 feet long of the iguanodon type and smaller carnivorous species. These bones are at least five million years old, but beautifully preserved. They probably are related to European types and, with our former work, indicate that Central Asia is the ancestral home of the dinosaurs, which migrated to Europe and America.

The expedition is now divided into two parts. One is working in the dinosaur beds and the other exploring later geological strata. The second group, camped 24

miles south of the first, is working in eocene deposits, the dawn period of mammalian life. The strata are extraordinarily rich in fossil remains. We have discovered the skull of a giant rhinoceros—like the beast known as the titanothere, which, although it has been buried for three million years, is almost as perfect as though the animal had died a week ago. The titanotheres were previously only known in America. Finding this particular stage in their development shows that they crossed from America by way of a former land bridge to Asia.

We have found, also, remains of a giant dog-like carnivore, as well as many teeth and jaws of an ancestral tapir-like animal. We could spend easily a year's work in these great deposits, but will give them only enough time to get a few of the choicest things.

THE GODMAN AND SALVIN MEMORIAL

A TABLET in memory of Frederick Du Cane Godman, F.R.S., and Osbert Salvin, F.R.S., has been unveiled by Lord Rothschild, chairman of the memorial committee, at the Natural History Museum, South Kensington, and accepted on behalf of the trustees of the British Museum by the Archbishop of Canterbury.

The London *Times* notes that these two distinguished men of science were intimately associated in research and the results of their labors form an important part of the treasures of the Natural History Museum. The friendship between them dated from the fifties of the last century, when they were both undergraduates at Cambridge, and lasted until the death in 1898 of Salvin, who was survived twenty-one years by Godman, the latter dying in 1919, in his eighty-sixth year. In 1876 the two friends conceived the idea of the monumental work entitled *Biologia Centrali-Americana,* which has been described as without doubt the greatest work of the kind ever planned and carried out by private individuals.

As completed, the Biologia consists of sixty-three volumes, of which one forms the introduction, fifty-one are devoted to zoology, five to botany, and six to archeology. The work was edited by Salvin and Godman, and after Salvin's death by Godman alone. The three volumes on the birds and three others on the diurnal lepidoptera were prepared by Godman and Salvin themselves, while the others were written by various specialists. The volumes contain 1,677 plates, of which more than nine hundred are colored, and the total number of species is 50,263, of which 19,263 are described for the first time.

In 1885 Godman and Salvin resolved to present their wonderful neo-tropical collections to the British Museum. Of birds' skins alone over 520,000 were contained in this magnificent donation, which included not only the collections made by Salvin and Godman themselves, chiefly in Guatemala, but many others from various parts of South America, the Mexican collections obtained by Godman himself and his collectors, made in that country in 1887, and the great Henshaw collection of the birds of the United States containing over 13,000 specimens, which was secured by Godman in order to provide a thoroughly authentic series of North American birds for comparison with those of Mexico and Central America.

The commemorative tablet, with portraits in relief of Salvin and Godman, is placed on the wall of the central hall of the museum, near and behind the statue of Darwin.

Lord Rothschild, in presenting the tablet on behalf of the subscribers, explained that the committee had decided that any subscriptions left over after the memorial had been paid for should be devoted to a collecting fellowship. Shortly after that decision Dame Alice Godman and the Misses Godman devoted a further sum of £5,000 to the Godman Exploration Fund, to which others had given further donations.

The Archbishop of Canterbury, in accepting the tablet, expressed the cordial welcome given by the trustees to gifts of that kind. Mr. Godman was one with whom it had been his privilege to sit for years as one of the trustees on the committee of management of museum affairs. Those who shared that privilege knew well how wide was the range of his knowledge and how applicable it was to almost anything that might arise. The Archbishop commended the setting up of memorials of great representatives of science and great benefactors to the museum. In Mr. Godman they had not only one of the donors to whom they owed so much, but also a valued trustee. He wanted to emphasize the importance which seemed to him to attach to taking care that such names, such acts, such memories and such lives should not be forgotten by those who looked at the specimens and collections the museum contained. He believed that in thus recording the services rendered by men such as Mr. Godman and Mr. Salvin they were serving the best interests of the museum.

SIR WILLIAM THISELTON-DYER

THE following letter, printed in *Nature,* has been addressed by British botanists to Sir William Thiselton-Dyer, who celebrated his eightieth birthday on July 28:

The occasion of your eightieth birthday affords us the opportunity of which we gladly avail ourselves, not only of offering you our congratulations upon having attained so venerable an age, but also of assuring you of our continued regard and esteem. In doing so we who sign this letter do but acknowledge our indebtedness to you for the inspiration and guidance which we, both as teachers and researchers, have derived directly or indirectly from your own early work as a professor of botany. We regard that work, and more especially the courses of practical instruction conducted by you at South Kensington

in the years 1875 and 1876, as having inaugurated the renaissance of the study of the structure and functions of plants which had been so brilliantly carried on by British botanists in earlier times. It must, we feel sure, afford you great and justifiable satisfaction to contemplate the marvelous development of such studies in this country during the years that have passed since you quickened them into new life.

The professorial career on which you had embarked so brilliantly was unfortunately, as it may have seemed at the time, brought to a close by your appointment to the assistant directorship of Kew in 1875 and your subsequent appointment as director ten years later. The work that you were enabled to carry out at Kew has been of such national importance that, however much we may regret the loss of the stimulating influence you would undoubtedly have exerted as a professor, we all realize the great and lasting services you have rendered to botany, not only from the purely scientific point of view, but also in relation to the development and encouragement of botanical enterprise throughout the British Empire.

Another notable result of the interest you inspired was the successful launching of the *Annals of Botany*, which has come to be one of the leading botanical periodicals of the world. We do not forget that it was your enthusiasm that turned the scale when the question of "to be or not to be" hung in the balance. The *Annals* is a lasting monument to your courage and prescience.

It would need a lengthy document were we to attempt to set out in detail the value of your many efforts for the promotion of our science, but in conclusion we feel we must refer to the noble work you did in saving the old Chelsea Physic Garden from destruction. Thanks to you, London has now a botanic garden where students and teachers can study the structure and functions of plants and pursue those studies which you did so much to promote.

With our very kind regards and good wishes,
Believe us to be, dear Sir William,
Yours very truly,

D. H. SCOTT	F. KEEBLE
S. H. VINES	A. B. RENDLE
F. O. BOWER	A. SHIPLEY
BALFOUR	H. WAGER
H. T. BROWN	F. F. BLACKMAN
D. PRAIN	V. H. BLACKMAN
F. DARWIN	F. W. OLIVER
H. H. DIXON	A. G. TANSLEY
A. C. SEWARD	F. E. WEISS
J. B. FARMER	A. W. HILL

and all the leading botanists in Great Britain and Ireland.

SCIENTIFIC NOTES AND NEWS

THE University of Strasbourg has conferred the title of doctor *honoris causa* on Drs. Simon Flexner and Jacques Loeb, of the Rockefeller Institute for Medical Research; William H. Welch, of the Johns Hopkins University; William Maddock Bayliss and Ernest Henry Starling, of the University College of London; John Newport Langley, of the University of Cambridge; Edward L. Ehlers, of the University of Copenhagen; Jules J. B. Bordet, of the University of Brussels; Edoardo Perroncito, of the University of Turin, and Santiago Ramon y Cajal, of the University of Madrid.

AT the general public meeting of the American Chemical Society on Tuesday, September 11, addresses of welcome will be delivered by C. H. Hall, chairman of the Milwaukee Section; Hon. Daniel Hoan, mayor of Milwaukee; Hon. Emanuel Philipp, president of the Milwaukee Association of Commerce, and President Fox, of Milwaukee University. The general addresses at this meeting will be delivered by Dr. Charles F. Burgess, who will speak on "Marketing chemical discoveries," and Dean R. T. Kendall, of the Medical School, Northwestern University, who will speak on "Bacteria and the chemist."

THE following awards have been made by the Royal College of Physicians, London: The Baly gold medal, given every alternate year for distinction in the science of physiology, to Mr. J. Barcroft; the Bisset-Hawkins medal, bestowed triennially for work in advancing sanitary science or in promoting public health, to Dr. T. M. Legge.

AT the International Surgical Congress recently held in London, Dr. Davide Giordano, Venice, Italy, was elected president to succeed Sir William Macewen. The predecessors in the presidency of these congresses were: Kocher, of Berne; Czerny, of Heidelberg; Championnière, of Paris; Depage, of Brussels, and Keen, of Philadelphia. The next congress will be held in Rome.

WE learn from the *Journal* of the American Medical Association that more than twenty physicians of Ontario were candidates at the recent elections to the Canadian Parliament. The following physicians were the successful candidates: Joseph D. Monteith, Stratford; the Hon. David Jamieson, Durham; Arthur G. Wallis, Algoma; Leeming Carr, East Hamilton; George V. Harcourt, Parry Sound; Forbes E. Godfrey, West York, and John P. Vrooman, Lennox.

THE National Alliance for the Increase of the French Population has awarded the first prize of 50,000 fr. to M. Paul Haury for the best popular pamphlet on the decreasing birth rate in France and the tragic consequences to the nation.

SIR RICHARD GLAZEBROOK has been appointed chairman in charge of exhibits in pure science at the British Empire Exhibition to be held next year in London.

PROFESSOR A. SMITHELLS has been appointed director of the Salters' Institute of Industrial Chemistry, London.

CLARKE E. DAVIS, chief chemist of the National Biscuit Company, and vice-chairman of the New York Section of the American Chemical Society, will succeed Dr. C. A. Browne as chairman of the section when the latter assumes his new duties as chief of the Bureau of Chemistry of the Department of Agriculture.

DR. WALTER G. CAMPBELL, who has been acting chief of the Bureau of Chemistry, has been appointed director of regulatory work of the Department of Agriculture.

R. L. CORBY, director of the research laboratories of the Fleischmann Yeast Company, will open the symposium on "Bread Production," September 11, at the twenty-sixth annual convention of the American Bakers' Association, which will be held at French Lick, Ind., the week of September 9.

WILLIAM HARPER DEAN, formerly of the U. S. Department of Agriculture, has been appointed manager of a Bureau of Agriculture recently established by the Chamber of Commerce of the United States.

DR. ELLIOTT S. ROBINSON has been appointed as assistant director of the Division of Biologic Laboratories of the Massachusetts State Department of Public Health to succeed Dr. Robert N. Nye.

DR. FRANK L. KELLEY, lecturer in preventive medicine and hygiene, and director of the state hygiene laboratory at the University of California, has been appointed health officer of Berkeley to succeed Dr. Ernest H. Pape.

ON August 10, a complimentary dinner was given in San Francisco by the California Academy of Sciences and biologists of the San Francisco Bay region to Dr. and Mrs. Robert P. Bigelow, of the Massachusetts Institute of Technology. Resident naturalists of the Bay region to the number of twenty were in attendance.

DR. H. A. GLEASON, assistant director of the New York Botanical Garden, is spending two months at the Biological Station of the University of Michigan, Douglas Lake, Michigan, continuing researches on the application of statistical methods to the study of plant association.

DR. A. B. STOUT, director of the laboratories of the New York Botanical Garden, has returned to the garden after nine months at Pomona College, Claremont, California, where he was occupied with a study of fertility, sterility and pollination in the date palm, the avocado and the citrus fruits.

PROFESSOR HERMANN THOMS, dean of the Pharmaceutical Institute of the University of Berlin, has been visiting the United States on his way to lecture in Japan.

J. H. CROSSLEY, of the Metropolitan-Vickers Electrical Company, Manchester, England, was lately in the United States studying industrial electric heating developments for the purpose of promoting the application of electricity in England.

DR. GEORGE BIRD GRINNELL, in company with Christopher G. La Farge, New York architect; Col. Henry Hall, a Washington writer, and Barrington Moore, secretary of the National Parks Committee, began on August 21 a survey of the country west of the Big Horn Mountains as a possible national park site.

THE Department of Commerce has announced the personnel of the Caribbean rubber investigating party which sailed from the United States for Panama on July 25 to investigate the rubber plantation possibilities of Panama, Colombia, Venezuela, the Central American countries and Mexico. John C. Treadwell, of the Continental Rubber Company of New York, will be in charge of the party. Hugh H. Bennett, of the Bureau of Soils, Department of Agriculture, will accompany Mr. Treadwell as assistant.

DR. C. U. ARIENS KAPPERS, Amsterdam, director of the Netherlands central institute for research on the brain, has been appointed by the Rockefeller Foundation to give a course of lectures on the anatomy of the brain at the Peking Medical School, and will leave for China in August.

ON the topmost ledge of the rocks on Slide Mountain, the highest peak in the Catskills, the Winnisook Club, of Poughkeepsie, N. Y., on August 18 dedicated a tablet to the memory of the late John Burroughs. The tablet is affixed to the ledge under which Mr. Burroughs passed the night several times as he relates in "The Heart of the Southern Catskills."

AN international subscription has been opened to secure funds for the erection of a monument at Roscoff in memory of Dr. Yves Delage, under the auspices of M. Léon Bérard, minister of public instruction; M. Paul Appell, rector of the University of Paris; M. Picard and M. Lacroix, secretaries of the Academy of Sciences, and other men of science. Delage was a professor at the Sorbonne, and director of the biological station at Roscoff.

FETES in honor of Fabre, the famous French entomologist, began on August 6 at Millau (Aveyron). A monument, the work of the sculptor Malet, representing Fabre, a magnifying glass in his hand, examining

an insect, was unveiled. It was actually at St. Léons that Fabre was born, but St. Léons is a little village of a few hundred inhabitants, and it was thought desirable to erect the statue in the neighboring town of Millau. Fabre is chiefly associated with Sérignan, near Orange, for it was here in his garden that he pursued his entomological studies.

ACCORDING to the *Journal* of the American Medical Association the Paris branch of the Franco-Mexican Association has presented to the Pasteur Institute a replica of the medallion likeness of Pasteur that was hung on the walls of the department of medicine of the University of Mexico on the occasion of the centennial celebration. The bestowal of this work of art took place in the crypt of the institute, at the entrance to the tomb of Pasteur, the presentation speech being given by M. Honnorat, former minister and honorary president of the French section of the Franco-Mexican Association. Dr. Roux, director of the Pasteur Institute, expressed his thanks to the association for the gift and the honor accorded to the memory of Pasteur.

THE German societies for physics, the applied physical sciences and Roentgen rays held recently a joint meeting at Berlin in the large hall of the university in memory of Roentgen. The president of the republic and scientific men from all over the country spoke on the importance of Roentgen's discovery to different branches of science.

A COMMEMORATIVE tablet has been placed by the London County Council on the former residence of James Clerk Maxwell, physicist (1831–1879).

THE Hancock Life Insurance Company, Boston, has given $20,000 to the Harvard Cancer Commission, of which sum a fourth is to purchase diagnostic apparatus; the remainder is for the permanent fund. The insurance company previously gave $30,000 toward the building of the Huntington Hospital, which is devoted to cancer cases.

UNIVERSITY AND EDUCATIONAL NOTES

THE legislature has made special appropriations to the Michigan College and Station for the ensuing biennium of $1,070,000. This is in addition to the receipts from the mill tax, which aggregate about $1,000,000 and are used entirely for operating expenses. The principal items in the special appropriation are $400,000 for a horticultural building and greenhouse, $300,000 for extension work, $150,000 for a power house, $50,000 for a college hospital, $70,000 for research, and $100,000 for miscellaneous buildings.

PROFESSOR A. H. PATTERSON, head of the department of physics and dean of the School of Applied Science in the University of North Carolina, will spend the year 1923–24 in study at Harvard University, on leave of absence. His place will be filled during his absence by Dr. Paul H. Dike, who has been in charge of physics at Robert College, Constantinople, for some years past, though Dr. Otto Stuhlman, Jr., will serve as head of the department, while the duties of the deanship will be assumed by Dr. J. M. Bell, of the department of chemistry.

AT the University of Missouri, Eli Stuart Haynes, of Beloit College, has been elected professor of astronomy; Dr W. B. Robertson, of the University of Kansas, assistant professor of zoology, and Dr. H. C. Howard, Jr., assistant professor of analytical chemistry.

DR. A. RICHARD BLISS, JR., professor of pharmacology in the Emory University School of Medicine, Atlanta, has resigned to accept the professorship of physiology and pharmacology at the University of Tennessee. Dr. Monroe F. Brown, assistant professor in the department, also goes to Tennessee.

MR. J. BASIL BUXTON, now on the staff of the Medical Research Council, London, has been elected into the newly established professorship of animal pathology in the University of Cambridge.

M. GOSS has been elected to a newly established chair of mathematics at the University of Grenoble.

DISCUSSION AND CORRESPONDENCE

THE MARINE LABORATORY AT TORTUGAS

DURING the past year a number of papers appeared in SCIENCE and elsewhere[1] which discussed the desirability of continuing the Department of Marine Biology of the Carnegie Institution of Washington and its most important single activity, the laboratory at Tortugas. Since the officers of the Carnegie Institution have not yet announced what their policy toward the Department of Marine Biology is to be, it may be presumed that the question of continuing this department is still under consideration. This department, having been created in the interest of biologists working on tropical organisms, will probably be continued only if it is evident that a sufficient number of biologists are still actively interested in this kind of work.

[1] Davenport, SCIENCE, Vol. 56, p. 134.
Schaeffer, SCIENCE, Vol. 56, p. 468.
Crozier, SCIENCE, Vol. 56, p. 751.
Crozier, SCIENCE, Vol. 57, p. 498.
Fisher, SCIENCE, Vol. 57, p. 233.
Allen, SCIENCE, Vol. 57, p. 499.
Coe, *Amer. Jour. Sci.*, Ser. V, Vol. 4, p. 173.
Potts, *Nature*, Vol. 110, p. 224.

The papers to which reference was made above are unanimous in agreeing that the Department of Marine Biology should be continued, but there is divergence of opinion as to the desirability of continued operation of the laboratory at Tortugas, the alternative suggestion being the establishment of a *permanent* laboratory of the type of Wood's Hole, Plymouth or Naples and located somewhere in the tropics or the subtropics or in Bermuda or southern California. It is with reference to the latter suggestion that I wish to contribute the following observations to the discussion.

As a general proposition, biologists would probably be almost unanimous in welcoming the establishment of a permanent laboratory in another faunal and floral region than the one Wood's Hole now draws upon; there is no doubt that its facilities could and would be used to advantage. But since it seems only a remote possibility at best that such a station will be established at present because of the great expense involved, it seems to me to be far more in the interest of biology to urge instead the retention of a station already in effective operation. It may be added that because of the more or less temporary nature of the laboratory at Tortugas, it could be moved to another locality without great expense, and its transformation into a permanent station at Panama or Jamaica or any of the localities named above, could be effected at any time in the future at no greater expense than would attach to such change now. It may be presumed that as soon as a considerable body of biologists strongly feel the necessity of a permanent station in our southern waters the Carnegie Institution or some other agency of research will take the matter under serious consideration.

In weighing the desirability of continuing the operation of the Tortugas station the following seem to me to be among its outstanding qualities and should receive careful consideration:

1. For American biologists, Tortugas is the best equipped and most accessible tropical marine station.

2. It has been in effective operation for eighteen years and the large amount of published results emanating from it are generally admitted to be of high order.

3. The work carried on there could not for the most part have been done satisfactorily at any other station. It does not compete with but complements the work of other stations.

4. There is evident demand for a station like Tortugas. During the past eighteen years 68 different investigators studied there, each investigator spending on the average three seasons at the laboratory.

5. The living and working conditions are entirely satisfactory.

This point needs a word of explanation. In the earlier years of the laboratory the living conditions were undoubtedly "trying" to a few of the investigators. In recent years, however, a new laboratory has been built and the old one remodeled and the cuisine has been greatly improved, so that the living and working conditions are now in fact considered almost ideal by most of the investigators. One can work ten hours a day every day through the entire season of eight or ten weeks and remain in perfect physical condition. It is not unusual indeed for one to gain in weight while working at this rate.

Altogether the Tortugas laboratory seems too effective an instrumentality for furthering biological science to allow it to lapse with nothing definite in view to take its place.

A. A. SCHAEFFER

HISTORICAL NOTE ON THE PROBLEM OF LIGHT DEFLECTION IN THE SUN'S GRAVITATIONAL FIELD

A SERIES of articles recently published by Professor T. J. J. See, U. S. Navy,[1] gives a quite incorrect impression of the relation of J. Soldner's and of Einstein's work in connection with the deflection of light in the sun's gravitational field. It therefore seems desirable to make a short statement of the history of this problem.

In 1801 Soldner[2] calculated the deflection of light according to (1) The corpuscular theory of light (light consisting of material particles which are subject to gravitation), and (2) Newton's law of gravitation. The problem was simply that of determining the hyperbolic orbit of a small mass traveling with the speed of light under the influence of the gravitation of a celestial body. Considering a ray of light just touching the surface of the attracting body, Soldner worked out the well-known solution of the problem of two bodies. In setting up the differential equations for the motion of the particle he erroneously used for the gravitational force the expression

$$2gr^{-2}$$

where g = acceleration at the surface of the attracting body, and
r = distance from the center of the attracting body (adopting the radius of this body as unit distance).

The factor 2 has no justification and should be omitted.

Designating by ω the angular deflection of light from a star at infinity until it reaches the surface of

[1] San Francisco *Journal*, May 13, 20, 27; 1923.

[2] Bode, "Astronomisches Jahrbuch für das Jahr 1804," Berlin, 1801, p. 161.

the attracting body Soldner derived the formula

$$(1) \qquad \tan g\, \omega = \frac{2g}{v\sqrt{v^2 - 4g}} \quad (v = \text{speed of light})$$

which he applied to the earth and the sun. On account of the mistake mentioned his result for the sun

$$(\textit{half deflection}) \ \omega = 0''.84$$

is twice too large. Correcting Soldner's formula and using modern constants a ray of light just grazing the sun's surface is deviated from infinity to infinity by the angle

$$\alpha = 0''.87$$

if the corpuscular theory of light and Newton's law of gravitation are adopted.

Soldner did not have in mind any test of the theory of light, his sole purpose being to find out whether the gravitational light deflection need be taken into account in astronomical measures of star positions. He was chiefly interested in the effect of the earth's gravitation upon a stellar ray, and he gave the application to the moon and the sun only a short mention at the end of his paper.

Before establishing the generalized theory of relativity, Einstein touched the subject of light deflection in 1908[3] and developed it more fully in 1911.[4] In the second paper Einstein states his principle of the equivalence of a uniform gravitational field with an accelerated system of reference. This principle leads to the necessary conclusion that energy of radiation (light) has inertia or mass, and that this mass must be subject to gravitation. From this conclusion the deflection of light could be calculated by using Soldner's method. Einstein, however, follows an entirely different course. For the time measure of an observer, according to the principle of equivalence, the speed of light in a gravitational field changes from place to place. The path of a light ray is then found by using the Huyghens principle, which leads to the formula

$$(2) \qquad \alpha = \frac{2kM}{c^2\Delta}$$

where α = full deflection of light ray from infinity to infinity

k = constant of gravitation

M = mass of attracting body

Δ = distance of light ray from attracting body

c = speed of light in vacuum.

For the sun Einstein finds $\alpha = 0''.83$, but with more accurate data the value $\alpha = 0''.87$ is obtained. This formula (which is based on the principles (1) Light is subject to gravitation, (2) Gravitation follows Newton's law) is equivalent to Soldner's formula, but is more general.

[3] "Jahrbuch der Radioaktivität und Elektronik," 4, 411, 1908.

[4] "Annalen der Physik," 35, 898, 1911.

In 1916[5] Einstein published his "Generalized Theory of Relativity," in which a new law of gravitation is given, differing from Newton's law by small terms, which, however, become sensible close to the sun, as for example, for the planet Mercury and for light rays passing near the sun. The light deflection required by this generalized theory is twice the amount given by formula (2); Einstein gives 1''.7 at the sun's limb, but more accurate calculation gives 1''.75. The increase of this value over that in Einstein's 1911 paper is not due to any mistake in calculation in the earlier paper but is an effect of the difference between Einstein's and Newton's law of gravitation, as the 1916 deflection is essentially based on the principles:

(1) Light is subject to gravitation.

(2) Gravitation follows Einstein's law instead of Newton's.

The observations of the 1919 and 1922 eclipses confirm the amount of light deflection predicted by the generalized theory of relativity of 1916 and they should therefore be considered as supporting the two last named principles. There is at present no other theory which satisfactorily explains the observed light deflections as to their numerical values.

The relation of Soldner's work to Einstein's results is characterized by the following points:

(1) It is through a mistake made by him in his work that Soldner obtains an amount of light deflection at the sun's limb which is in agreement with the recent eclipse observations; his theory, correctly developed, can only furnish a basis for half of the observed deflection. Einstein's generalized theory of 1916, on the other hand, necessarily leads to the full deflection observed.

(2) The fundamental assumptions on which Soldner's work is based are equivalent, as far as the present problem is concerned, to those of Einstein's 1911 paper, and Einstein's 1911 results must be and are in agreement with those of Soldner (after correcting Soldner's mistake).

(3) Soldner treats only the case of a light ray grazing the surface of the attracting body; Einstein considers the more general problem of any light ray passing through a gravitational field, and his formula (2) not only gives the light deflection at the sun's edge but also states that for other light rays the deflections are inversely proportional to the distance from the sun's center, a law which is not even touched by Soldner.

(4) The two authors derive their formulae by entirely different methods.

(5) Einstein's result differs from Soldner's formula not only in notation but also in terms of higher

[5] "Annalen der Physik," 49, 769, 1916.

order, and Einstein does *not* repeat Soldner's mistake.

(6) Soldner does not mention the application of this problem for testing the theory of light which is the principal purpose of Einstein.

This comparison sufficiently shows the independence of Einstein's work even if he knew about Soldner's paper, which is not likely, as Soldner's result had fallen into oblivion following the rejection of the corpuscular theory of light on which it is based. Professor See, accusing Einstein of plagiarism, clearly has not read Soldner's original paper and has been misled by a fragmentary reprint[6] of it published in 1921 together with comments by a German physicist, P. Lenard.[7] In these comments (page 603) Lenard transforms Soldner's formula into a notation and form similar to that employed by Einstein. Professor See mistakes Lenard's transformed formula for Soldner's and bases his unfounded accusation upon its similarity to Einstein's result.

ROBERT TRUMPLER

LICK OBSERVATORY

A RECESSIVE BLACK VARIETY OF ROOF RAT

THE pelage color of most wild mammals is characterized by a rhythmical deposition of dark and light pigments in the hair, giving rise to what is termed an agouti pattern. One of the common variations occurring in agouti animals is the disappearance of the bands of yellowish pigment, which results in a totally black coloration, provided no other variations are present simultaneously. It is known that mammals may be black genetically, for one or other of the following reasons: (1) Because they possess a dominant or incompletely dominant extension factor, which extends the dark pigments into the regions ordinarily occupied by the lighter ones only, as in "steel gray" rabbits;[1] (2) because they possess a recessive non-agouti factor which precludes the formation of light pigments in the hair with the dark ones. Most black varieties of domesticated animals belong to the latter class.

The natural color of the black rat, *Mus rattus*, is a uniform black, which has been found to be dominant over the agouti of the closely allied roof rat, *Mus alexandrinus*.[2] This case obviously falls into the first of the above-named categories. Black individuals obtained from a stock received from Mr. H. C. Brooke of Taunton, England, were at first supposed to be specimens of the dominant black derived from *M. rattus*. These blacks were produced in matings between grays and yellows, and it was assumed at first that black would be found to be dominant over gray as in Morgan's experiments. The incorrectness of this assumption was apparent when gray mated to gray produced litters containing black animals; six black rats produced in this way have been recorded. Matings of such black males to wild gray *M. alexandrinus* females have resulted in the production of seventeen offspring, all of which are gray.

This evidence indicates very clearly that we have in this black variety a color factor which is different from the one characterizing the black rat, *Mus rattus;* one which is recessive to gray or agouti, and which is probably the homologue of the factor producing the black variety in the Norway rat, the house mouse, the guinea-pig and the rabbit.

HORACE W. FELDMAN

BUSSEY INSTITUTION,
FOREST HILLS, BOSTON, MASS.

QUOTATIONS

A "ROSS INSTITUTE"

THE approaching twenty-fifth anniversary of Sir Ronald Ross's epoch-making discovery that malaria is transmitted to man by the mosquito has led a number of influential persons, including leaders of the profession in this country, Mr. H. H. Asquith (ex-prime minister), Dr. Roux, director of the Pasteur Institute, Paris; Dr. R. M. Strong, of Harvard University; Dr. William H. Welch, of Johns Hopkins, and Sir Charles Sherrington, president of the Royal Society, to make an appeal to the public. They point out that the discovery has revolutionized medical science and living conditions throughout the tropics and, among other great things, enabled the Panama Canal to be constructed. It is impossible to exaggerate the services Ross has rendered. He must be ranked among the great investigators whose labors, like those of Pasteur, Lister, Jenner and Golgi, have conferred inestimable and lasting benefits on mankind. All the world has shared in these benefits, but Great Britain, which has vaster tropical areas than have ever been ruled by a single power, has profited most abundantly, and she owes a very special debt of gratitude to the son who has rendered this service. There is in

[6] "Annalen der Physik," 65, 593, 1921.

[7] Lenard, it should be said, recognizes the error in Soldner's work to which attention is called in this paper and gives correctly the value for the deflection to which Soldner's theory leads. It may further be stated that Soldner's result for the light deflection by the Earth $\omega = 0''.001$ is also in error and should be $\omega = 0''.00014$ (in addition to the erroneous factor 2 in the formula a mistake was made in calculating the value of the acceleration for the peculiar units used).

[1] Punnett, R. C., 1912, *Jour. Genet.*, 2, 1915; *ibid.*, 5.

[2] Morgan, T. H., 1909, *Am. Nat.*, 43.

process of organization an institute to be called the "Ronald Ross Clinique for Tropical Diseases and Hygiene," in which it is proposed that laboratory research and clinical investigation shall be combined as closely as possible in accordance with his teaching. There are already in this country two schools of tropical medicine which have done good work, but their activities are in the main educational. It is proposed that the institute shall supplement and not compete with them; that its primary object shall be research, that a clinical establishment shall be maintained in intimate conjunction with the laboratories, and that the master mind of Ross, assisted by other experts, shall have the fullest scope for the initiation and continuation of researches into the still unsolved problems of tropical medicine. There is a Pasteur Institute in Paris; a Kitasato Institute in Japan; a Gorgas Institute in Panama. It is strongly felt that Great Britain should honor one of her greatest investigators by establishing a Ross Institute in London. To initiate this, $250,000 is required. The public is invited to send subscriptions to the honorary treasurer, Lord Willoughby de Broke, 29 Queen Anne Street, London.—*The Journal of the American Medical Association.*

THE DIRECTORSHIP OF THE RECLAMATION SERVICE

SECRETARY WORK might have given a shorter explanation of the recent removal of Arthur Powell Davis, Director of the Reclamation Service, which would have been more convincing. If he had merely said that Mr. Davis was turned out to make room for a practical politician, that would have been enough.

In his long letter addressed to the American Society of Civil Engineers, Secretary Work labors the point that the time when engineering skill and experience were of first importance in the Reclamation Service is past and that the need now is for "a practical business man familiar with conditions peculiar to irrigation in the West" as Director. The facts are that Arthur Powell Davis was for twenty-one years an engineer in the Reclamation Service, that since 1914 he had been director, and during his term of service all the large storage dams of the West were constructed and others begun, and that Gov. D. W. Davis, of Idaho, who succeeds him, has been known only as a grocer and banker who entered state politics.

The charges that big power interests have conspired to bring about the removal of the distinguished engigeer because they are opposed to the Government's policy in reclamation and Arthur Powell Davis's part in it under successive administrations Secretary Work passes over in silence. His answer to the engineers is lame and evasive. To confess the truth would be to admit the unworthiness of his own motives in removing from office Arthur Powell Davis to make room for an Idaho politician.—*The New York World.*

SPECIAL ARTICLES

THE VIBRATIONAL ISOTOPE EFFECT IN THE BAND SPECTRUM OF BORON NITRIDE

THE quantum theory of band spectra[1] indicates that there should be quite appreciable differences between the spectra of isotopic molecules. This is essentially because the spectroscopic frequencies, or, rather, such portions of them as are due to changes in molecular vibrational energy, should be proportional to actual molecular vibration frequencies. The expected isotope effect has already been found[2] in one of the *infra-red absorption* bands of hydrogen chloride; here the absorbed energy is nearly all vibrational.[3] A displacement of 0.055 A.U. has also been found in a comparison of certain lines in the *visible emission* bands of two samples of lead of different atomic weight. Here the emitted radiant energy is partly vibrational, partly electronic in origin.[4]

A much more favorable case than the two foregoing is to be found in boron nitride. Here the vibration frequency should be 2.76 per cent. greater for the lighter isotope $B_{10}N$ than for the heavier, $B_{11}N$, as compared with 0.08 per cent. for HCl and perhaps 0.04 per cent. for lead. The ratio of abundance, 1:5 from the atomic weight 10.83 (Baxter & Scott), is of course somewhat unfavorable. Jevons[5] has measured the heads of two systems of bands which he has satisfactorily shown to be due to boron nitride. In addition to the main "α" and "β" systems, he found certain less developed "subsidiary systems," β_1 and β_2, related to the β system, as well as some extra bands not fitting any system.

Theory predicts that for the band due to the passage of a vibrationless, but electronically excited molecule, to an electronically less excited, and still vibrationless, state, there should be *no isotope effect*

[1] See, for example, Sommerfeld, "Atombau und Spektrallinien," 3rd Ed., Chap. VI.

[2] Loomis, *Astrophys. Journal*, 52, 248 (1920); Kratzer, *Zeit. für Physik.*, 3, 460 (1920).

[3] There is also a change in molecular rotational energy involved, with a corresponding isotope effect. This is, however, usually a minor factor, and will not be considered in the following discussion.

[4] Grebe and Konen, *Phys. Zeit.*, 22, 546 (1921). The emitting molecule is probably that of some lead compound.—The effect should not be confused with those observed in the *line* spectra of lead isotopes.

[5] W. Jevons, *Roy. Soc. Proc.* A, 91, 120 (1915).

except the very small electronic effect corresponding to that in line spectra.[3] This band may be designated (0, 0), since it corresponds to the change $(n'=0)\rightarrow(n=0)$, n' and n respectively denoting the *initial* and *final* number of vibrational quanta possessed by the molecule. The band (0, 0) is usually one of the more intense members of a band system. On the high frequency side of (0, 0) lie bands for which $n' > n$, or strictly, for which $W_{n'} > W_n$, W denoting vibrational energy. Here the electronic energy emission is supplemented by a contribution from the vibrational energy; the reverse is the case for the bands on the low-frequency side, where $W_{n'} < W_n$. Going from (0, 0) toward either shorter or longer wave-lengths in the band system, there should be a progressively increasing displacement between the bands of two isotopes, the frequencies all being *higher* on the *high*-frequency side for the *lighter* isotope, and *lower* on the *low*-frequency side. The reason for this is that the intervals between successive bands are approximately proportional to the molecular vibrational frequencies, so that the bands of the lighter isotope are on a somewhat *more extended scale* than those of the heavier.

In order to apply the theory to the boron nitride bands, it is first necessary to determine the proper values of n and n′ for each band. This can be done without great difficulty with the help of certain criteria applied by Heurlinger to the cyanogen and nitrogen bands. The following equation then gives, in wave-number units (*in vacuo*), by substitution of suitable values of n and n′, the positions of all the 50 heads of the β system

$$\nu = 42885 + 1268.5n' - 10.20n'^2 - 1873n + 11.85n^2.$$

The (0, 0) band lies at $\nu = 42885$ ($\lambda = 2331$ A.U. (in air)); the values of n run from 0 to 10, those of n′ from 0 to 5.[6]

On examining Jevons's data on the position of the β_1 and β_2 systems, it is found that the β_1 bands all lie at lower frequencies than the $(0, 0)\beta$ band, and the β_2 bands all at higher frequencies. Furthermore, the β_1 band nearest $\beta(0, 0)$ lies *very near* $\beta(0, 2)$, on the *low*-frequency side; and the β_2 band nearest $\beta(0,0)$ lies *very near* $\beta(1, 0)$, on the *high*-frequency side. Going toward lower and higher frequencies, respectively, the β_1 and β_2 bands become gradually more and more separated from the corresponding β bands. Moreover, each β_1 or β_2 band is *weaker* than the corresponding β band. All this is exactly what would be expected if the β_1 and β_2 bands belong to the lighter isotope $B_{10}N$. This idea is very greatly strengthened by a comparison of the frequency intervals between neighboring β bands (*e.g.*, the bands (1, 3) and (1, 4), or (1, 4) and (1, 5)) with the intervals between corresponding β_1 or β_2 bands. The theory predicts that these intervals should be approximately proportional to the molecular vibration frequencies, and should therefore be greater for $B_{10}N$ than for $B_{11}N$ approximately in the ratio 1.0276. Making the comparison above suggested for every possible pair of β_1 or β_2 bands with the corresponding pair of β bands, an average value of 1.029 is actually obtained for the ratio. In view of the inexactness of the theoretical prediction,[7] the agreement is very good.

The explanation of the apparent gap between the β_1 and β_2 systems is obviously that the bands of the two isotopes lie very near together in this region. There remain a number of bands which should belong in the β_1 system, but which appear to be missing. The positions of these bands can be calculated by means of the following empirical equation which holds for both the β_1 and the β_2 bands:

$$\nu = 42871 + 1306.5n' - 10.50n'^2 - 1925n + 12.188n^2$$

It is then found that the head of every missing $B_{10}N$ band, with three exceptions, should lie just inside the head of a more intense $B_{11}N$ band, so as to be completely masked by the latter.[8] The three remaining bands are accounted for by three bands observed, but not correlated, by Jevons. A $B_{10}N$ band corresponding to *every* observed $B_{11}N$ band of the β system is thus either observed or accounted for.[9]

The maximum displacements between corresponding bands for the two isotopes are of notable magnitude, *viz.*, 4.5 A.U. toward shorter wave-lengths at λ 2145 (band (3, 0)), and 34.1 A.U. toward the red at λ 3256 (band (3, 9)).

The evidence given above as to the presence of a corresponding set of bands for each of the two isotopes of boron nitride leaves little room for doubt, especially in view of the fact that the absence of such bands would seem to involve the overthrow of the present theory of band spectra. There are, however, certain apparent minor discrepancies and gaps in the data, which it is hoped to remove by means of new

[6] A corresponding equation has also been determined for the α system, but as the present data on the isotope effect are much more fragmentary than for the β system, the α system will not be discussed here.

[7] This is due to the fact that the measurements refer to band heads. This introduces a variable rotational isotope effect whose magnitude it is not possible to calculate exactly with the data at hand, but which should, qualitatively, increase the ratio above 1.0276, in agreement with observation.

[8] In most cases the $B_{11}N$ band does not correspond to the same values of n and n′ as the $B_{10}N$ band which it masks.

[9] Note the close approach for the calculated position of the (0, 0) band to that for $B_{11}N$. Discussion of the significance of the remaining difference (presumably electronic isotope effect) will be postponed.

experimental work which is now under way.[10] A detailed discussion will therefore be postponed.

ROBERT S. MULLIKEN,
National Research Fellow
JEFFERSON PHYSICAL LABORATORY,
HARVARD UNIVERSITY

HYDROGEN ION CONCENTRATION AND THE DEVELOPMENT OF SCLEROTINIA APOTHECIA

RECENT experiments, performed under the general direction of Dr. J. B. S. Norton, have demonstrated a marked relation between the growth of the apothecial stage of the sclerotinia causing brown-rot of stone fruits and the hydrogen ion concentration of the substrate. The special significance of this relation is due to the following facts: As is now well known, the perfect or apothecial stage of the fungus arises in spring from old mummied fruits on the ground. Mature Sclerotinia apothecia are usually first noted as they discharge ascospores at the time peach trees are blooming, but previous to this time these apothecia have been developing slowly on the ground for a number of weeks. Hence there is a period of weeks, prior to the time when any infection can be caused by the ascospores, during which the apothecia are exposed to possible injury. With this idea in mind a number of experiments, of which a few will be summarized here, have been performed on the effect of different environmental conditions on the developing apothecia.

A preliminary experiment was made in the spring of 1922, using peach mummies with the sporophores developed just sufficiently to protrude from the sclerotia as light brown, rod-like stipes. The mummies were suspended in glass tumblers containing unbuffered HCl and NaOH solutions, to which final pH determinations gave a range of only pH 4.5 to 7. Apothecia developed rapidly to maturity in all. Meanwhile similar peach mummies had been placed partly buried in sand in some pots, and powdered sulphur dusted on in quantities equivalent to 100, 500 and 1,000 lbs. per acre. The apothecia were coated with sulphur, but after temporary inhibition for six days the treated apothecia grew even more rapidly than the checks. In the three treated pots the soil solution reached a pH of 3.5 (colorimetric).

The experiments above had revealed remarkable acid tolerance in developing apothecia, and this phase was followed up in the spring of 1923. Well-buffered solutions were used in a series from pH 1.4 to 11.9, at intervals of about one pH unit. When young apothecia were grown in these, the optimum seemed to be near pH 2.5 with good growth from 1.4 to 5.8. At pH 6.8 growth occurred, but the apothecia did not mature; at 7.7 and higher no growth was observed. Using more nearly mature apothecia, growth was seen in one case near pH 9.5; otherwise, the results were as in the other series.

It seemed probable from this that slight alkalinity in the soil should be sufficient to inhibit the growth of Sclerotinia apothecia. Some peach mummies with developing apothecia were placed in pots of sandy soil, and hydrated lime applied in quantity and with the results indicated in Table I. Note especially the initial inhibition and final development of apothecia in pot 1 in connection with the falling pH in this pot.

TABLE I

Effect of hydrated lime on growth of apothecia

Pot No.	$Ca(OH)_2$ in lb. per acre	pH after 1 day	pH after 14 days
1	125	6.81	6.55
2	625	6.65	6.65
3	5000	7.30	10.70
4	0 (check)	5.99	6.40

Pot No.	Development of apothecia after 1	6	10	14	20 days
1	—	—	trace	++	+++
2	—	—	—	—	—
3	—	—	—	—	—
4	++	+++	+++++	++	−

WALTER N. EZEKIEL
UNIVERSITY OF MARYLAND AGRICULTURAL EXPERIMENT STATION

[10] Preliminary measurements on the visible part of the boron nitride spectrum now indicate equally good agreement with theory for the α as for the β system, and a quantitative analogy between the two systems in respect to the relative positions of the $B_{10}N$ and $B_{11}N$ bands. The fact that each $B_{11}N$ α band has two pairs of heads, whose structure lines overlie and often resemble the corresponding $B_{10}N$ band heads, tends to obscure the latter, except far from the (0, 0) band, and accounts for Jevons's failure to note $B_{10}N$ heads. A number of the $B_{10}N$ heads are, nevertheless, plainly visible, with the present set-up, even in visual examination of the spectrum. The isotope heads are unmistakable in the two red bands, (0, 4) and (1, 5). For the latter, the stronger pair of $B_{10}N$ heads (middle of pair at λ 6462) lies 94 A.U. farther to the red than the corresponding $B_{11}N$ pair (middle of pair at λ 6368). Some new α bands in the extreme red show an even greater isotope effect. In the ultraviolet, Jevons's data include three unidentified heads which agree closely with calculated positions for $B_{10}N$ head pairs of the α system. One is evidently the weaker head pair of the (4.0) band (the expected stronger pair for this band should, according to calculation, coincide with the weaker $B_{11}N$ pair). The other two heads ($\lambda\lambda$ 3353.3 and 3369.3) evidently are those of the (5.0) band of $B_{10}N$; these lie 18 A.U. farther into the ultraviolet than the corresponding $B_{11}N$ pairs ($\lambda\lambda$ 3373.5 and 3386.8).

SCIENCE

VOL. LVIII SEPTEMBER 7, 1923 No. 1497

CONTENTS

SCIENCE: A Weekly Journal devoted to the Advancement of Science, edited by J. McKeen Cattell and published every Friday by

THE SCIENCE PRESS

Lancaster, Pa. Garrison, N. Y.

New York City: Grand Central Terminal.

Annual Subscription, $6.00. Single Copies, 15 Cts.

SCIENCE is the official organ of the American Association for the Advancement of Science. Information regarding membership in the association may be secured from the office of the permanent secretary, in the Smithsonian Institution Building, Washington, D. C.

Entered as second-class matter July 18, 1923, at the Post Office at Lancaster, Pa., under the Act of March 3, 1879.

THE SIZE OF THE UNIVERSE[1]

THE century in which we live promises to make an incalculable advance in man's power of exact measurement. "Nearly all the grandest discoveries of science," says Lord Kelvin, "have been but the rewards of accurate measurement and patient, long-continued labor in the minute sifting of numerical results." The opening decades of the century have witnessed the emergence of a number of fundamental natural phenomena, the explanation of which defies all the mighty power of Newtonian mechanics. The Newtonian laws have hitherto been found adequate to explain large-scale phenomena; but there seems convincing reason for grave doubt as to their applicability to small-scale phenomena. "The old laws," as Jeans observes, "are not, so to speak, fine-grained enough to supply the whole truth with regard to small-scale phenomena." Nor are they exact enough to explain very minute changes in large-scale phenomena. Conspicuous among contemporary theories which throw grave doubt upon the universal applicability of the Newtonian mechanics are the electron theory of Lorentz, the quantum theory of Planck and the relativity theory of Einstein. The Lorentz transformation, basic in the electron theory, belies Newton's ideas of absolute space and time. Crucial in the quantum theory is the phenomenon that "the total radiant energy per unit volume of ether in temperature-equilibrium with matter is finite"; and to explain the facts of radiation according to Planck's law the Newtonian mechanics are inadequate. The remarkable explanation of the observed discrepancy in the advance of the perihelion of Mercury, and the phenomenal accord of observation with theory in the matter of the light-ray deflection announced by W. W. Campbell a few weeks ago, thitherto unexplained by the Newtonian mechanics, constitute supreme triumphs for Einstein's relativity theory.

To-day are going forward profound investigations, at each end of the scale of magnitudes—towards the infinitesimal and towards the infinite. Methods of almost incredible refinement are being devised for determining the scale of the atom and the scale of the universe. The investigations of Rutherford have virtually set it beyond doubt that the atom consists of a central nucleus of almost infinitesimal dimensions, and of electrons revolving in planetary manner

[1] Presidential address before the North Carolina Academy of Science, Greensboro, N. C., May 5, 1923.

around the nucleus. The hydrogen atom consists of a negative electron revolving in an orbit round a positive nucleus of equal charge, while the helium atom consists of two electrons revolving in orbits round a nucleus with a positive charge equal in amount to twice that of an electron. The scale of the universe to the atom is believed to be 10^{22} to 1. The radius of the solar system is 10^{14} centimeters. This, on dividing by 10^{22}, becomes 10^{-8} centimeters, the radius of an atom. As Aston recently pointed out, "the atom, like the solar system, is *empty;* and what we measure as its spherical boundary really only represents the limiting orbits of its outermost electrons." An atom of hydrogen, on being enlarged by the factor 10^{22}, would become of the same size as the solar system; and its two planetary electrons would closely resemble Uranus and Neptune as regards size, distance from the sun and period of revolution. If in the atom of helium, for effective comparison of size and distance, the nucleus were represented by a rather large pea, its planetary electrons would be represented by two somewhat smaller peas revolving around it at the distance of a quarter of a mile.

These investigations of the atomic microcosm have concentrated attention upon the fundamental structure of the universe. It would seem that aggregations of matter, ranging from the infinitesimal to the infinite, possess the features of the solar system. Each particle of the atom may be a little world after analogy with this world now rotating beneath our feet at the rate of 1,000 miles per second. Our solar system is one among countless many others of the Milky Way; and perhaps the Milky Way is but one of countless giant nebulae whirling in spiral form through a space that may be infinite. While the mathematicians and the physicists, Lorentz, Planck, Poincaré, Thomson, Rutherford, Millikan, Soddy, have been turning their brains, their microscopes and spectroscopes to a study of the atom, the astronomers, Shapley, Kapteyn, Russell, Hertzsprung, Eddington, DeSitter, Curtis, have been utilizing their telescopes, interferometers and coelostats in the study of the new heavens revealed by the epochal advances in photography and spectroscopy. Until the time of Galileo, the "crystalline lens of the human eye, limited by the iris to a maximum opening about one quarter of an inch in diameter," was the only collector of starlight. Galileo's telescope, of 1610, with a lens-area about eighty-one times that of the pupil of the eye, vastly extended for the astronomer the boundaries of the visible universe, bringing to view stars down to the magnitude 10.5, of which nearly half a million are known to exist. Through the development of the photographic telescope and the use of the spectroscope, within recent years, astronomers have caught hundreds of millions of star-images upon the photographic plate and for the first time through spectral images and luminosity curves began to make some credible computations regarding the scale of the universe. In his presidential address before the British Association for the Advancement of Science, Eddington recently remarked: "Probably the greatest need of stellar astronomy at the present day, in order to make sure that our theoretical deductions are starting on the right lines, is some means of measuring the apparent angular diameter of stars." Recent observations at the Mt. Wilson Observatory, with the use of the Michelson interferometer, have greatly increased our knowledge of the apparent angular diameters of giant stars, and given us a new and enlarged conception of the magnitude of the visible universe. On December 13, 1920, by the use of the Michelson interferometer, Pease found that the angular diameter of Betelgeuse, Arabic for the "Giant's shoulder," the conspicuous red star in the right shoulder of Orion, was $0''.047$; and assuming a parallax of $0''.018$, the linear diameter of α Orionis turned out to be 240,000,000 miles. To help us to understand what this means, we may say that the angular diameter of Betelgeuse is that of a ball one inch in diameter, seen at a distance of seventy miles. This giant star, which is but a tiny point of light to the naked eye, would completely fill the orbit of Mars; and if placed in the position of our sun would shoulder out the sky and we should see only a blazing firmament of fire. If a boy of fourteen were to fire around Betelgeuse a bullet with the unchanging velocity of 2,800 feet per second, the highest known velocity for a projectile, the bullet would not complete the circuit until he had reached the Biblical age of threescore years and ten. A ray of light from Betelgeuse, traveling at the rate of 186,-330 miles per second, would take 160 years to reach us; which means that Betelgeuse is distant from the earth about one quadrillion miles.

In any attempt to measure the sidereal universe, it is necessary to increase enormously our units of measurement. In ordinary mensuration upon the earth, we employ the units: inches, feet, yards. In measuring the moon, on account of the great magnifying power of the modern lens, it is possible to use the mile as a unit. The next unit we resort to is the diameter of the earth—say some 8,000 miles. But in order to measure the distances from the sun to its attendant planets, it is necessary to use a unit 12,000 times the diameter of the earth—the *astronomical* unit —93,000,000 miles, the distance from the earth to the sun. But in order to measure the very great distances from star to star, which are as remote from each other in some cases as a thousand million astronomical units, it is necessary to use a still greater unit, the *light-year.* As light travels with the velocity

of about 186,000 miles per second, it is easy to compute the distance light travels in a year, which is something less than six million million miles. It is only by the use of such a yardstick as the light-year that one can satisfactorily take the scale of the sidereal universe.

While stars of the magnitude of Betelgeuse and Antares can be studied by the use of parallax methods, the globular clusters of the type of Omega Centauri and Hercules are so remote as to defy the astronomer in the attempt at determination of their distance from us by the geometrical measurement of parallax. By observing that, in each of the clusters where variable stars appear, the brightest stars of the cluster are, on the average, three times as bright, photographically, as the variables, Shapley has computed the distances from us of the principal globular clusters. Measuring the brightness of the brightest stars in any cluster, Shapley obtained results for some 30 clusters which are truly amazing. He found that the nearest of the globular clusters—Omega Centauri and 47 Tuscanae, both in the southern hemisphere—are distant from us about 22,000 light-years. The great cluster in Hercules is about 35,000 light-years away; and the remotest cluster, No. 7006, is at the enormous distance of 220,000 light-years—at least fifty times as far away as the remotest star whose distance can be measured by other methods.

Now our galaxy, delimitated for us by the projected contours of the Milky Way, is shaped much like a lens or a thin watch, the thickness being probably less than one sixth of the diameter. Astronomers are agreed that within this galaxy, which contains possibly a billion suns, the stars are not infinite in number nor uniform in distribution. Twenty years ago Newcomb remarked that the "sun *appears* to be in the galactic plane because the Milky Way is a great circle—an encircling band of light—and that the sun also *appears* near the center of the universe because the star density falls off with the distance in all directions." And yet he confesses: "Ptolemy showed by evidence which, from his standpoint, looked as sound as that which we have cited, that the earth was fixed in the center of the universe. May we not be the victim of some fallacy, as he was?" This very week, Painlevé, the distinguished French mathematician, made this extraordinary statement: "Under the old teachings it was explained that the world turned on its axis and in space. Of course, this is mere talk for children; no such thing occurs, but such explanations must be given so the ignorant can have a mental picture of what the universe is like. Neither the earth nor the stars whirl in space." Are we *all*, indeed, the victim of some strange fallacy?

To primitive man, the physical universe was anthropocentric. Eventually, with Ptolemy, came the conception of the geocentric universe. Since the time of Copernicus, astronomers have believed in a heliocentric universe—a universe in which the sun was considered to be at or near the center of the stellar universe. Shapley's investigations lead us to believe that the sun is at least 50,000 light-years from the galactic center. His study of the Cepheids—variable stars of short period named from the star Delta Cephei—have led to truly remarkable conclusions regarding the size and remoteness of these variable stars. They vary considerably in brightness from time to time, and also show corresponding alterations in color, being redder when faint, whiter when bright. Since spectroscopic observations of their motion in the line of sight show that the "peculiar" motions of these stars are unusually small, it was possible to devise trustworthy values for the average distance of these stars by considering their "parallactic drift" due to our motion in space past them. As the result of the observations of Russell, Hertzsprung and Shapley, it has been found that the average brightness of a Cepheid of period six days, is 750 times that of the sun; that a Cepheid with a period of 100 days is 23,000 times as bright as the sun; and that a Cepheid at maximum brightness is 30,000 times as bright as the sun. Computation on this basis shows that the Small Magellanic Cloud, one of the two remarkable outlying patches, similar to the Milky Way but remote from it, in the southern hemisphere, is at a distance from us of 62,000 light-years. A Cepheid of 100 days period is 800 times the sun's diameter—700 millions of miles—big enough to include all the inner planets of the solar system within its bulk, and almost as large as the orbit of Jupiter.

Shapley has calculated the actual positions in space of the 69 clusters definitely recognized as globular; and he finds that they, themselves, form a huge flattened cluster, probably 300,000 light-years in diameter, and about 100,000 light-years in thickness. "Since the affiliation of the globular clusters with the galaxy," says Shapley, "is shown by their concentration to the plane of the Milky Way and their symmetrical arrangement with respect to it, it also follows that the galactic system of stars is as large as this subordinate part. During the past year we have found Cepheid variables and other stars of high luminosity among the fifteenth magnitude stars of the galactic clouds; this can only mean that some parts of the clouds are more distant than the Hercules cluster. There seems to be good reason, therefore, to believe that the star-populated regions of the galactic system extend at least as far as the globular cluster."[2]

[2] *Bulletin of the National Research Council*, Vol. 2, part 3, No. 11: "The scale of the universe" by Harlow Shapley and Heber D. Curtis, 1921.

The center of this colossal globular star system is, according to Russell, some 70,000 light-years from the sun. The final conclusion, to which I would especially call your attention, is that, according to these truly arresting investigations, the diameter of the whole system of globular clusters is about the same as the diameter of the galactic system, namely, 300,000 light-years. This figure will, later on in this paper, furnish comparison with a remarkable investigation of Einstein regarding the size of the universe.

The largest figure hitherto given for the diameter of the galaxy was 60,000 light-years, advanced by Kapteyn. Other figures are Wolf, 14,000 light-years; Eddington, 15,000 light-years; Newcomb, 30,000 light-years. The new methods and the recent computations of Shapley, Hertzsprung, Russell and Miss Leavitt indicate a diameter for the galaxy some 10 times the figure ordinarily accepted by astronomers in the past. There appears, however, to be a definite limit to the size of the stellar universe. Stars of the second magnitude are 3.4 times as numerous as those of the first, those of the eighth magnitude are three times as numerous as those of the seventh, while the sixteenth magnitude stars are only 1.7 as numerous as those of the fifteenth magnitude. "This steadily decreasing ratio," says Hale, "is probably due to an actual thinning out of the stars towards the boundaries of the stellar universe, as the most exhaustive tests have failed to give any evidence of absorption of light in its passage through space."

Poets, philosophers, scientists throughout all the ages have regarded the universe as infinite. The book of Job gives us that awful image of an infinite void in the words: "He stretcheth out the north over the empty space, and hangeth the earth upon nothing." In propounding his doctrine of the infinity of the worlds in space, Giordano Bruno thunders out the mighty lines:

> Now unconfined the wings stretch out to heaven,
> Now shrink beneath a crystal firmament
> Aloft into the aether's fragrant deeps,
> Leaving below the earth-world with its pain,
> And all the passions of mortality.

On metaphysical grounds alone, Kant affirmed that space is infinite and is sown with similar stars in all parts.

Is the universe infinite? If a voyager of the skies travels in a straight line deep into the inter-stellar spaces, past the great blue helium stars of Orion, past Betelgeuse and Antares, beyond the white variable Cepheids, the gaseous red and yellow giant-stars, the colossal globular clusters, and beyond even the faintest of the super-nebulae whirling in fiery spirals in the dim void of remoter space—will he ever reach a limit of the sidereal realm? That is the profound and provocative query which has recently been raised anew by Einstein. In the Milky Way there are perhaps as many stars as there are now human beings living upon the earth. Beyond those dense masses of stars, such as the Magellanic Clouds, and beyond the great globular clusters which hover about the fringes of the Milky Way, lie vast wastes of desert space, devoid of stars over incalculable expanses. Beyond this, says Nordman, lie those strange bodies, the spiral nebulae, "lying like silver snails in the garden of the stars." Astronomers are divided in opinion to-day in regard to these spiral nebulae, of which there are known to be more than a million—whether to regard them as "island universes," systems like that of the Milky Way and comparable to it in their dimensions, or merely as annexes of the Milky Way, reduced models of it. These spiral nebulae have the enormous average space velocity of 1,200 kilometers per second; and their radial velocities and distribution, the maximum luminosity attainable by a star, the dimensions of our own galactic system, incline certain contemporary investigators to the hypothesis that the spiral nebulae are members of the galactic organization. Poincaré's calculation of the number of stars in the Milky Way agreed fairly closely with the number counted, which, taken together with other considerations, was opposed to an indefinite extension of the stellar universe.

What answer does the Newtonian mechanics give to the query: Is the stellar universe infinite? According to this theory, if there were an attenuated swarm of fixed stars of approximately the same kind and density, however far we might penetrate the interstellar spaces, then matter would have a finite mean density; and the intensity of the gravitational field at the boundary of the universe would be *infinite*—which is impossible. According, then, to the Newtonian theory, the mean density of matter must be infinitesimally small; and the cosmos must present the picture of an island of finite extent surrounded on all sides by infinite empty space. Such a view is repugnant to our minds, since the light of the stars and isolated stars themselves would drift away into the infinite, and this ephemeral cosmos would gradually melt away and disappear. Astronomical observation does not support the view that the energy of the cosmos is gradually being dissipated. To obviate these inevitable but incredible consequences of the Newtonian theory, it is necessary: either to assume with Seeliger, which is a purely *ad hoc* hypothesis, that the attraction of masses decreases at great distances somewhat more rapidly than in inverse proportion to the square of the distance; or else to assume that the number of stellar systems and stars is finite.

In a famous paper, "Cosmological Observations

Concerning General Relativity," published in the *Report of the Berlin Academy of Science*, February 8, 1917, Einstein advanced the view that the universe is finite, but unbounded. This statement sounds paradoxical, but brief reflection will show that a thing may be unbounded without being infinite. A being which moves on the surface of the earth, or indeed of any sphere, may travel over it indefinitely without ever reaching any boundary or limit. Similar considerations, extended to three-dimensional curved space, enable us to see how the universe may be at the same time finite and unbounded. Einstein assumed that the matter of the universe was distributed with uniform density; and that the stellar system is approximately at rest, since the velocity of the stars is very small as compared with the velocity of light. Assuming further the existence of pressure inside the electrically charged particles of matter in the universe, Einstein showed by elaborate calculations based on general relativity that space is "spherical" in structure, in the Riemann sense. In reality this means that space is "quasi-spherical" in the Riemann sense somewhat as the earth is quasi-spherical in the Euclidean sense, because of local corrugations. The Einstein universe is quasi-spherical, since matter does not actually occupy space uniformly and is not really at rest, but only shows the same density of distribution as a mean and has a very low velocity as compared with the velocity of light.

The "spherical" space here referred to is curved space—which means that according to Einstein the geometry of our universe is not Euclidean. The universe, moreover, does not have the shape of a sphere. It is not a three-dimensional space cut out of four-dimensional space—as is a sphere a two-dimensional space cut out of a three-dimensional space. It possesses the following properties: All lines starting from a point intersect again in the antipodal point measured along any of these lines. These straightest lines are closed and have a total length of $2\pi R$ where R is the "radius" of the universe. The greatest possible distance between two points is πR; and there is only one point, the antipodal point, at this distance from a given point. If a stellar body move through spherical space, its size gradually increases until it reaches its maximum at the universe's outer verge; and there, as it were, re-entering the universe it gradually diminishes in dimensions until it ultimately reaches its original size and position. Every point stands in the same relation to the rest of space as does every other point. There is no boundary to spherical space, and no center. The formula for the total volume of this spherical space is $2\pi^2R^3$.

Another extraordinary feature of this spherical space is that, neglecting the absorption of light, we should see a star-image of a given star at the opposite point in the heavens. If we look at some faint star in the Milky Way, the radiant pulses of energy give us a vision of the star, not as it is now, but as it was in the days of Tut-ankh-amen; and at the opposite point of the heavens we shall see an image of this same star—not as it was when the Egyptians were building the pyramids, but as it was perhaps in the prehistoric days of ancient Phoenicia. Who knows but that many of the stars we see in the firmament are not real but only ghosts of stars haunting the heavens from the days of remotest antiquity?

In this spherical space, according to Helmholtz, "we imagine the more distant objects to be more remote and larger than they are. But we find on approaching them that we reach them more quickly than we expected from their appearance. But we also see before us objects that we can fixate only with diverging lines of sight, *viz.*, all those at a greater distance from us than the quadrant of a great circle. . . . The strangest sight in the spherical world would be the back of our own head, in which all visual lines not stopped by other objects would meet again, and which must fill the background of the whole perspective figure." To those inclined to be sceptical of the existence or even of the conceivability of such a world, I need only suggest that you can see a world of spherical space by looking out at our own world through a slightly prismatic glass with the thicker side towards the nose.

In the graduate mathematics seminar at the University of North Carolina, we have made this year a thoroughgoing study of spherical space and the universe, according to Einstein's general relativity theory. The volume of this universe, expressed in grams, is 7 followed by forty-one ciphers, divided by the mean density of matter to the 3/2 power; and the mass of this universe is 7 followed by forty-one ciphers divided by the square-root of the mean density. If we assume that the average density of matter in the universe is the same as that of the Milky Way, we find that the radius of the universe is at least 150 million light-years; or, since the distance from the earth to the sun is 93,000,000 miles, the radius of the universe is 1 million times 10 million times the distance from the earth to the sun. Choosing the Milky Way as yardstick, of 30,000 light-years, according to the figure of Curtis, it will take 10,000 Milky Ways, laid end to end, to arrive at the diameter of the universe. The greatest sphere of water which could be included in the universe would have a radius of 300 million kilometers. Using the diameter of the earth's orbit as a measuring rod, we shall need 10 trillions of these units to take the measure of the diameter of the universe.

The weight of the universe, in grams, would be 1 followed by fifty-four ciphers—which would carry

us into the nonillions of grams. The weight of the Einstein universe bears the same relation to the weight of the whole earth as the latter bears to a kilogram. The weight of the earth to that of the sun is as 1 to 324,000. Hence we should have to take a trillion suns to get the weight of the universe.

It would take a ray of light, traveling at the rate of 186,000 miles per second, one billion years to go around the universe. To go around the universe it would take the fastest aeroplane 3 quadrillion years; the fastest automobile five and one half quadrillion years; and an express train, traveling at the rate of 60 miles an hour, 11 quadrillion years.

In conclusion, I wish to call your attention to the fact that the dimensions of this finite universe of Einstein are more than ample to include the spiral nebulae—whether regarded as galactic phenomena or even as island universes. On the assumption of approximate equality of size for celestial objects of the same class, which has been used by Shapley and other investigators, the extreme distance of the most remote of the spiral nebulae, considered as galactic phenomena, would be of the order of 10 million light-years; and, considered as island universes, would be of the order of 100 million light-years. Thus, even the most remote spiral nebulae would fall far within the bounds of the Einstein universe with its super-diameter of 300 million light-years.

Descartes, confronted with the question "What lies beyond?", always affirmed that a finite universe was impossible. This question has no meaning for Einstein because the foundation of general relativity is the doctrine that there is no space without matter or energy. If all the heavenly bodies we know belong to our galactic system, it is possible, says Einstein, that "other universes exist independently of our own." They may remain forever optically isolated from us by the phenomenon of the cosmic absorption of light. While other universes may palpitate beyond our own, no ray of knowledge, says Nordman, "could ever reach us from them. Nothing could cross the black, dumb abysses which environ our stellar island." We are doomed to dwell within a finite universe a thousand million times greater than the region now accessible to astronomical observation. Our glances are confined for ever within this giant—this all too minute—monad.

ARCHIBALD HENDERSON
THE UNIVERSITY OF NORTH CAROLINA

A NEW ERA FOR AMERICAN MUSEUMS

ON March 30, it was announced in SCIENCE that a grant of $30,000 had been made to The American Association of Museums contingent upon the raising of $55,000 more, and that the campaign for funds was expected to continue through the autumn of 1923. It is therefore a matter of pride to the association that announcement can be made now of the success of its project and of the consequent establishment of national headquarters at Washington, D. C.

This development signals the beginning of a new era for the association, of course, but much more than that, it is believed to mark the beginning of a new era for the museums of America.

Organization on a national scale to the end of maintaining a staff to work for a common cause has been found highly advantageous by local units in many fields. Most wide-spread interest has attached to industrial and commercial developments along these lines, but the same methods have been equally successful in fields of social, civic, religious and educational endeavor. The recourse by museums to organized cooperation is therefore not surprising, but it is a clear indication of the hopeful trend in museum affairs.

The funds now available have been contributed in part by individuals, many of whom are members of museum boards. Unfortunately no more than a dozen museum corporations have shared to any considerable extent in the financial burden, but it is hoped that the three-year demonstration, which is now assured of support, will bring about more general participation by museums. It is felt that the responsibility will have to be shared in equitable fashion by a majority of active museums before the movement can enter upon the road to permanent success. However, the work is now afoot, and the future will depend upon the success of activities during the next three years. For those who are most closely associated with the project, there is a great responsibility.

Fortunately there is no lack of interest and moral support on the part of museums—at least so far as official attitude can be judged by the consensus of opinion among some five hundred museum employees and trustees, who make up the active membership of the association.

The program which has been drafted looks far into the future, and there is no thought that more than a few of the most important projects can be initiated within the near future.

The Program

I. PROPAGANDA SERVICE FOR MUSEUMS.
  To acquaint the American public with the work and aims of museums.
  A. Press publicity—news items, articles and special departments in newspapers, magazines, trade papers and house organs.
  B. Screen publicity—production and circulation of films and slides showing the value of museums; efforts to induce producers of educational films to utilize museum material.

C. Platform publicity—establishment of a board of lecturers made up of trained museum workers willing to give an occasional lecture for the association in places where such a lecture would help to stimulate interest in museums; lectures by the field secretary.

D. Exhibit publicity—participation in expositions to the extent at least of showing a traveling exhibit to convey the museum idea and to show the value of a museum to the community, to industry, to schools, etc.

E. Enlisting the active interest of communities and of various organizations with a view to inducing the establishment and development of museums in every community and of special museums under the auspices of industrial concerns and other organizations.

II. PUBLICATIONS SERVICE.

To make available the results of headquarters service, field surveys and research and to supplement the propaganda service.

A. Technical publications.

For museum workers and those intimately interested in museums.

1. Museum Work—a class periodical devoted to special articles, technical discussions, news of museums, proceedings of the association and items of current value with reference to association service.
2. Monographs — on museum principles and practice.
3. Museum Data—a loose leaf report service for members devoted to reference material.

B. Popular publications.

For the general public.

1. Special pamphlets—containing articles which may be useful in quantity to museums for the furtherance of such work as a membership campaign.
2. Popular magazine—to be established later for the purpose of supplementing the propaganda service.

III. LOCAL SERVICE IN FIELD.

To bring to any community the latest museum information from the entire country, particularly with reference to notable support of museums by their respective communities and the establishment of new museums.

A. Personal surveys by field secretary and recommendations concerning such matters as:

1. Membership.
2. Educational work.
3. Publicity methods.
4. Extension work—assistance in preparing plans for correlating museum educational programs with school curricula.

B. Personal assistance of field secretary in such matters as:

1. Membership campaigns.
2. Interviews with local authorities.
3. Talks at meetings.
4. Local publicity.
5. Establishment of museum councils—to consist of officials of museums in one community to secure effective coordination of effort.
6. Establishment of educational councils—to consist of officials of museums, colleges, schools, libraries and other educational institutions to secure a wise and correlated plan for the educational forces of a city.

IV. HEADQUARTERS SERVICE.

A. Clearing house between museums and organizations in allied fields.

To avoid duplication of effort and to make mutually available information concerning activities and services such as:

1. Lecturers and lectures.
2. Traveling exhibits.
3. Material for exchange and inter-loan.
4. Slides and films.
5. Expeditions and explorations.

B. Service bureau.

To perform for museums demanded services along lines covered by the clearing house and not already rendered by other organizations, until such time as an organization in the appropriate field may be induced to assume the service.

C. Information bureau.

To collect and to disseminate useful information and to foster cooperation and interchange of information between museums; report service to answer inquiries concerning such matters as:

1. Buildings.
2. Exhibition.
3. Administrative methods.
4. Educational methods.
5. Publicity methods.

D. Employment bureau.

To supply information concerning available or needed museum workers; to arrange for exchanges of staff members.

E. Cooperation with foreign associations of museums.

To foster international relations.

V. ADVANCEMENT OF MUSEUM SCIENCE AND PRACTICE.

To foster research and the training of museum personnel.

A. Research.

1. Study and analysis of museum problems and, if possible, formulation of general principles.
2. Effort to induce study of museum problems by research students and organizations.

B. Personnel training.

1. Studies and committee work to outline courses of undergraduate and graduate study in museumology.

2. Efforts to secure introduction of such subject matter into college undergraduate courses in education, art, history and science.
3. Cooperation with universities to establish graduate work in museumology.
4. Studies and committee work to outline training courses to be conducted in museums.
5. Efforts to secure establishment of such training courses in museums.
6. Vocational guidance for students and apprentices.

During the first year emphasis will be placed upon four undertakings. First, the bi-monthly publication, *Museum Work*, will be developed in order that the joined forces of museums may have a voice. Second, researches into museum principles and practices will be undertaken by the staff or will be set afoot through the good offices of other agencies concerned with museum problems. Third, an information bureau and service-center will be established at the Washington headquarters. Fourth, an effort will be made to modify in some degree the present misconception and inadequate understanding of museums which exists in the public mind. Beyond these four projects the trend of work will be influenced by expediency and the evolution of plans as time elapses.

THE STAFF

The new director of the association is Charles R. Richards, who until recently was director of Cooper Union. Professor Richards has already sailed for Europe, where he is to make a survey of museums with special reference to educational and economic service in the field of industrial art—a project which is being financed by the General Education Board, though it is to be carried forward in part as an association activity.

During the first year the secretary, who has become a resident member of the staff, is functioning as acting-director and will initiate the new inter-museum enterprise.

LAURENCE VAIL COLEMAN,
Secretary

SCIENTIFIC EVENTS

THE NUMBER OF MEDICAL STUDENTS

ACCORDING to statistics collected by the *Journal* of the American Medical Association, the total number of medical students in the United States for the year ending June 30, 1923, excluding premedical, special and postgraduate students, was 17,432, an increase of 1,292 over last year. This is the largest enrolment of students since 1912. Of the the total number of students, 16,771 were in attendance at the non-sectarian (regular) colleges, 341 at the homeopathic, 99 at the eclectic and 221 at the three nondescript colleges.

Medical College Attendance

Year	Non-sectarian	Total
1880	9,776	11,826
1890	13,521	15,404
1900	22,710	25,171
1901	23,846	26,417
1902	24,878	27,501
1903	24,930	27,615
1904	23,662	28,142
1905	24,119	26,147
1906	23,116	25,204
1907	22,303	24,276
1908	20,936	22,602
1909	20,554	22,145
1910	20,136	21,526
1911	18,414	19,786
1912	17,277	18,412
1913	15,919	17,015
1914	15,438	16,502
1915	13,914	14,891
1916	13,121	14,012
1917	12,925	13,764
1918	12,727	13,630
1919	12,259	13,052
1920	13,220	14,088
1921	14,033	14,872
1922	15,247	16,140
1923	16,771	17,432

During the past year there were 1,030 women studying medicine, the largest number since 1905, when there were 1,073. The percentage of women to all medical students this year is 5.9. There were 214

Women in Medicine

Year	Total Women Students	Percentage of all Students. Both Sexes
1904	1,129	4.3
1905	1,073	4.1
1906	895	3.5
1907	928	3.8
1908	835	3.7
1909	921	4.2
1910	907	4.2
1911	680	3.4
1912	679	3.2
1913	640	3.8
1914	631	3.8
1915	592	4.0
1916	566	4.0
1917	610	4.5
1918	581	4.3
1919	686	5.2
1920	818	5.8
1921	879	5.9
1922	989	6.1
1923	1,030	5.9

women graduates this year, 60 more than last year. Of all the women matriculants, 119 were in attendance at the one medical college for women, while 911 (88.4 per cent.) were matriculated in the 65 coeducational colleges. From the one women's college there were 21 graduates, while 193 (90.2 per cent.) secured their degree from coeducational colleges.

DISCUSSION ON ORGANIC ELECTROCHEMISTRY

Of particular interest to the electrochemist is the announcement of a round table discussion on organic electrochemistry to be held during the fall meeting of the American Electrochemical Society, in Dayton, Ohio, on September 27, 28 and 29. Professor Charles J. Thatcher will preside over the discussion.

The topics selected for discussion are:

1. *The Present Status of Organic Electrochemistry:*
   This will comprise consideration of the Organic compounds now manufactured electrochemically, here and abroad, and the advantages of the electrolytic methods.
2. *The Future Development of Organic Electrochemistry:*
   Discussion under this topic will comprise:
   A—Enumeration of the Organic compounds which have been or are being investigated with a view to commercial production and announcement of forthcoming papers regarding such investigations.
   B—A consideration of the more serious difficulties encountered, generally, in development of electrochemical processes for the manufacture of organic compounds, and of means whereby these difficulties may be overcome. This topic should bring out opinions as to the better type of cell and diaphragm for acid and alkaline electrolyses, and whether non-diaphragm cells are practical.
   C—Discussion of fields for research and industrial developments and announcements of intended investigations to avoid duplication of work.

All members who are unable to be present at this discussion are invited to send in written communications which they desire read at the discussion, to the chairman of the committee, in care of the secretary of the society. There will be no stenographic record taken at this discussion.

THE LAKE STATES FOREST EXPERIMENT STATION

The last session of the Congress appropriated $50,000 for the establishment of two new forest experiment stations, one in the Northeast and one in the Lake States. The headquarters of the Northeastern Station has been established at Amherst, Mass., in cooperation with the Amherst Agricultural College. The headquarters of the Lake States Station will be in St. Paul, in cooperation with the University of Minnesota. This will be a regional station to take care of the forest problems arising in the Lake States region.

The projects of this station will include studies in reforestation, management, methods of cutting, slash disposal and other phases of forest growth and protection. Mr. Raphael Zon has been selected as the head of the new station.

Mr. Zon has been connected with the research work of the U. S. Forest Service for 22 years. He is editor of *The Journal of Forestry*, chairman of the Forestry Committee of the National Research Council, and is one of the veterans of the forestry profession in this country. He was graduated from Cornell University in 1901 and was the second forester to be graduated in the United States. He has always been especially interested in research problems; it was he who first started the experiment station idea in this country, and probably contributed more than any other forester to the development of the science of forestry. For many years forestry in the United States was entirely on an empirical basis. The Lake States Forest Experiment Station, and such other stations of the same character as the government has established and may establish in other places, is intended to assemble the necessary facts to place forestry on a firm scientific foundation.

Mr. Zon is already on the grounds and will soon be joined by four other members of his technical staff—J. A. Mitchell, Jos. Kittredge, H. Grossman and A. E. Wackerman.

E. G. Cheyney

INSURANCE OF THE RESULTS OF AN ECLIPSE EXPEDITION

According to press reports a policy of $10,000 against failure through weather conditions has been taken out by the Swarthmore University expedition to Yerbaniz, Mexico, where on September 10 photographs of the sun's eclipse will be taken.

This is said to be the first time that a scientific expedition has been insured. The policy was obtained by George H. Brooks, a Swarthmore alumnus, through the Home Insurance Company. The premium is $500. It is doubtless the shortest term policy ever issued by a company, since it remains in force for two minutes and fifty-nine seconds, the time during which it will be possible to photograph the eclipse.

Explaining the decision of Swarthmore University to protect the expedition against the elements, Mr. Brooks wrote to the insurance company:

The photographs of the solar eclipse taken by the expedition, which is under the leadership of Dr. John A. Miller of Swarthmore University and head of the Sproul

observatory, will be of incalculable value to science if they can be secured. To equip such an expedition as this requires a large sum of money, and there is an ever present possibility of failure at the last moment should atmospheric conditions at the time be such as to affect the visibility and to make the taking of the photographs an impossibility.

To compensate for possible loss of time and money, and to enable future expeditions to carry on the work with the same funds until they are rewarded with success, the Swarthmore expedition desires to go to Mexico armed with insurance against those conditions over which they have no control.

The policy, which is written under the rain insurance form, provides:

If by reason of weather conditions affecting visibility only, or by vibration of instruments caused by winds in the State of Durango, Mexico, on Sept. 10, 1923, between 2:34:17 P. M. and 2:37:16 P. M., or thereabouts, standard time, the insured is prevented from taking photographs of scientific value of the eclipse of the sun, then this company shall be liable for and shall pay the amount set forth in the schedule below.

The schedule sets forth the description of the cameras used and the number of plates to be exposed. The policy provides further that the determination of the scientific value of the pictures shall be left to Professor George H. Peters, of the United States Naval Observatory, Washington, D. C. His findings are to be conclusive and binding upon both parties.

THE LIVERPOOL MEETING OF THE BRITISH ASSOCIATION

THE ninety-first annual meeting of the British Association will be held at Liverpool from September 12 to 19. According to the London *Times* it promises to be larger than any of its predecessors, it being expected that between 3,000 and 3,500 persons will attend, of whom about 1,500 will be visitors. The last meeting in Liverpool was in 1896, when Sir Joseph Lister was the president. This year Sir E. Rutherford occupies that position, and the subject of his address will be the "Electrical structure of matter." There are thirteen sections, and five addresses by their presidents will be delivered on September 13, five on September 14 and three on September 17.

It has been the rule at many previous meetings for the British Association to devote particular attention to some branch of scientific study relevant to the town which it is visiting. Last year, at Hull, sea fisheries formed the subject for consideration; and this year geologists and geographers are making a special feature of subjects which are of local interest to Liverpool and district. Professor P. G. H. Boswell will open a discussion at the first meeting of the geological section on the "Geology of the Liverpool District," and Sir A. Strahan, ex-director of the Geological Survey, will discuss the "Geography of the Liverpool District from Pre-Glacial Times to the Present"; while in the geography section papers on "The Region around the Mersey and Dee Estuaries" will be submitted by Mr. W. Hewitt, Mr. H. King and Mr. K. C. Moore.

The association will be strong this year in the attendance of foreign representatives. Ten or a dozen leading Canadian scientists are going, and their presence may be regarded as having particular reference to the meeting of the association next year at Toronto and the arrangements that will be made by the general committee in relation thereto. There are altogether about thirty foreigners expected, mostly French and Danes. Among them are Professor Langevin, of Paris; Signor Conti, of Florence; Dr. Coster and Dr. Henesy, of Copenhagen; Dr. Roule, Paris; Professor Jesperson and Professor N. Bohr, of Copenhagen.

An addition to the program is an address by Dr. F. W. Aston, of Cambridge, who gave an "Atomic theory" lecture last year at Hull, on new matter which has been the result of his past year's work. In the Engineering and Psychology Sections discussions will take place on "Vocational tests for engineering trades." Afternoon meetings are said to be becoming a feature of increased importance. The committee has found that these fixtures are appreciated, and they have been fixed, therefore, for 5 o'clock, because people who cannot attend the meetings of the association during working hours can be present at that hour. These addresses will be given by Dr. G. H. Miles on "Vocational Guidance"; Dr. C. S. Grundy on "Teaching Music to Children," with an orchestral demonstration; Dr. Schmidt on "The Dana expeditions and their work on the life-history of the eel."

On Tuesday evening, the eighteenth, a scientific *soirée* will be given at the Liverpool University. This is a new feaure, and is on the lines of the Royal Society's *soirées* in Burlington House, Piccadilly, with demonstrations and short lectures. Another feature is the scientific exhibition, which will be run by the Liverpool authorities, at which a large number of scientific instrument makers will be the exhibitors.

SCIENTIFIC NOTES AND NEWS

THE Pan-Pacific Scientific Congress, in which fourteen nations are represented, was opened at Melbourne on August 13, with the presidential address by Sir David O. Masson.

DR. EDGAR F. SMITH, provost emeritus of the University of Pennsylvania and past-president of the American Chemical Society, has been made an Officer of the Legion of Honor of France. The insignia

and brevet have been transmitted to him through the French Embassy at Washington.

DR. ARTHUR A. NOYES, director of the Gates Chemical Laboratory of the California Institute of Technology, has been elected an honorary fellow of the Royal Society of Edinburgh. There are fifty-seven honorary fellows of the society, seven of whom are Americans, of these a majority are from the Pacific coast, namely, in addition to Dr. Noyes, William Wallace Campbell, president of the University of California and honorary director of the Lick Observatory; George Ellery Hale, honorary director of the Mt. Wilson Observatory; Douglas H. Campbell, professor of botany, Stanford University. One of the other three members, Dr. Albert A. Michelson, professor of physics at the University of Chicago, is also research associate of the Mt. Wilson Observatory and the California Institute of Technology.

THE delegates to the forty-seventh meeting of the French Association for the Advancement of Science included Dr. Gerson, from the British Association; Sir William Pope, from the University of Cambridge; Dr. Aleš Hrdlička, of the U. S. National Museum; M. Carracido, rector of the University of Madrid; Professor Pittiard, of Geneva, and M. Boccardi, director of the observatory at Turin.

PROFESSOR EHLERS, of Copenhagen, the authority on leprosy, has been nominated honorary professor of Strasbourg University.

THE title of professor has been conferred by the faculty of science of the University of Paris on MM. Julia, mathematics; Maugain, mineralogy; Blaringhem, botany, and Michel-Levy, petrography.

AT the meeting of the council of the Royal College of Surgeons of England on July 12, Sir John Bland-Sutton was elected president in succession to Sir Anthony Bowlby, who had held that office for three years. Sir Berkeley Moynihan, Bt., professor of clinical surgery in the University of Leeds, and Mr. H. J. Waring, surgeon to St. Bartholomew's Hospital and vice-chancellor of the University of London, were elected vice-presidents.

DR. RAOUL GAUTIER, director of the Observatory and professor in the University of Geneva, Switzerland, has been elected to honorary membership in the Washington Academy of Sciences in recognition of his prominence in geodesy and his intimate connection with scientific work in Washington.

M. JEAN BOSLER, assistant astronomer at the Paris Observatory, has been appointed director of the observatory at Marseilles in the place of the late M. Bourget.

DR. C. ROBERT MOULTON, previously head of the department of agricultural chemistry in the University of Missouri, has been appointed director of the bureau of nutrition of the American Meat Packers Association. Miss Gudrum Carlson, formerly of Teachers College, assumes direction of the bureau of home economics.

C. J. ALBRECHT, curator of zoological exhibits at the University of Washington, has been appointed first assistant to the chief of museum exhibits at the American Museum of Natural History of New York City.

DR. V. L. BOHNSON has resigned as assistant professor of chemistry at the University of Wisconsin, to join the staff of the Oldbury Electrochemical Company, Niagara Falls, N. Y.

THE American Public Health Association will make an annual award to the city of one hundred thousand population or over that can show the most nearly adequate community health service by January, 1924, and the most progress after that date, according to statements made in the daily papers. The committee, consisting of Professor C. E.-A. Winslow, of Yale; Dr. Donald B. Armstrong, Professors Freeman and Frost, of Johns Hopkins, and Dr. L. R. Thompson, of the U. S. Public Health Service, will have the matter in charge in cooperation with the Metropolitan Life Insurance Company.

DR. ALLER G. ELLIS, formerly associate professor of pathology at Jefferson Medical College, Philadelphia, has sailed for Bangkok, Siam, where he will take charge of the pathological department of the Royal Medical College, Bangkok, under the auspices of the Rockefeller Foundation of New York.

WE learn from the *Journal* of the Washington Academy of Sciences that Mr. W. E. Myer, of the Smithsonian Institution, has returned from Tennessee where he has been excavating the Great Mound Group in Cheatham County. He found traces of an important ancient town covering 500 acres in two adjoining bends of Harpeth River. Many earth-lodge sites were excavated which yielded a considerable amount of information as to the life of the former inhabitants.

STEPHEN PASCHALL SHARPLES, consulting chemist, died at Deer Island, Maine, on August 20, at the age of eighty-one years. Mr. Sharples was known for his research on the adulteration of foods and on rubber. He was a fellow of the American Academy of Arts and Sciences and of the American Association for the Advancement of Science.

DR. JAMES LEONARD CORNING, the neurologist, known for the discovery in 1885 of spinal anaesthesia, died on August 25 at Morristown, N. J.

DR. MICHAEL P. C. POTVLIET, chief chemist of the Dominion Sugar Company, died on August 3, aged fifty-seven years.

THE bodies of Sir Henry Hubert Hayden, director of the Geological Survey of India, and his two guides, who left Lauterbrunnen, August 10, for an excursion up the Jungfrau, were found on August 30 on the west base of the precipice on the Finisteraarhorn.

THE centenary of the death of Brégnet will be commemorated at the Congress of Chronometry to be held at the observatory of the Sorbonne. There will be an exhibit of his works and of instruments designed by Brégnet and his son Antoine in the gallery of the museum from October 25 to November 24. An international exhibit of chronometers will be organized in September at Neuchâtel.

PROFESSOR GOLDSCHMIDT writes from Berlin under date of July 25: "The readers of SCIENCE might be interested in the following item: To-day the Prussian Academy of Science voted this year's research grants. I have added to each its value in gold at today's rate of exchange: Professor Guthnick for thermo-electric measurements of stars, 100,000 marks = 22 cents; Professor Pompecky for his work on the Tendagusu fossils, 80,000 marks = 18 cents; Dr. F. Leng for his work on the physiology of cell-division, 20,000 marks = 4 cents. The highest award is for work on Egyptian texts, 500,000 marks = $1.11. Further comment seems unnecessary."

THE Rockefeller Foundation has arranged to present to the German universities five copies each of the principal British and American medical journals. One copy will be given to the State Library of Berlin or Munich and the other four will be distributed among four groups in the north, south, east and west of Germany, each of which contains five or six universities. A journal will remain in the library of each university for two months.

THE Insulin Committee, recently organized to provide free insulin treatment for diabetics of New York City unable to pay for treatment, has announced the receipt of $2,500 from the New York Foundation; $2,500 each from the Hofheimer Foundation and Felix M. Warburg; $1,000 each from Marshall Field III, J. J. Wyle and Mrs. J. J. Wyle; $500 each from Frederick Strauss and Mrs. Jacob H. Schiff, and $250 each from Ellen C. Auchmuty, Jules S. Bache, Norman Goldman, John L. Wilkie and E. F. Albee. The treatment at present approximates $1.20 per day for each patient.

THE Intellectual Cooperation Commission of the League of Nations decided on July 29 to submit to the Council and to the Assembly of the League, a draft Convention for the Protection of Scientific Discoveries, drawn up by Professor Ruffini. In submitting this draft convention the commission is asking the governments to establish for scientific discoveries a copyright similar to that granted for literary and artistic work. With a view to helping towards the organization of intellectual societies, the commission advocates the creation of national commissions of intellectual cooperation, similar to those which already exist in various countries.

DELEGATES from the French Confederation and from five foreign countries (Belgium, Bulgaria, Finland, Great Britain and Switzerland) met recently in Paris and established the International Confederation of Intellectual Workers. The secretary has been empowered to draw up a constitution and by-laws, which will be sent for examination to the national confederations and will be submitted at the December session of the international body. The principal subjects for discussion at this session are: intellectual property (recognition of such property in all countries in which it is not yet recognized; its protection), and the creation of scientific property.

THE British Minister of Health has appointed a committee to inquire into the use of preservatives and coloring matters in food and to report (1) whether the use of such material or any of them for the preservation and coloring of food is injurious to health, and, if so, in what quantities does their use become injurious; (2) whether it should be required that the presence of such materials and the quantities present in food offered for sale should be declared. The committee is constituted as follows: Sir H. G. Monro, Professor W. E. Dixon, Sir A. D. Hall, Dr. J. M. Hamill, Mr. O. Hehner, Professor F. G. Hopkins, Dr. G. R. Leighton, Dr. A. P. Luff, Dr. C. Porter and Mr. G. Stubbs. The secretary of the committee is Mr. A. M. Legge, of the Ministry of Health.

THE Belgian government has granted a subvention to Professor M. Stuyvaert, of the University of Ghent, for the publication of his *Méthodologie mathématique*.

THE British Medical Research Council announced that it has awarded Rockefeller Medical Fellowships, tenable in the United States of America during the academic year 1923–1924, to the following: John Crichton Bramwell, medical registrar and registrar to the cardiographic department, Manchester Royal Infirmary. Norman McOmish Dott, assistant in the physiological department, University of Edinburgh. Helen Ingleby, assistant physician, Victoria Hospital for Children and South London Hospital for Women. Hugh Kingsley Ward, member of the scientific staff of the Medical Research Council, and working in the department of Pathology, University of Oxford. It is understood that further awards may be made during the coming academic year.

UNIVERSITY AND EDUCATIONAL NOTES

ON the completion of the state general hospital now under construction at a cost of $1,400,000 at the University of Wisconsin, the university plans a four-year course in medicine. The new hospital will have 300 rooms, twelve large wards and facilities for medical students to serve internships.

THROUGH an exchange agreement between Stanford University and Colorado Agricultural College, Professor Geo. T. Avery will take advanced work at Stanford the coming year.

PROFESSOR ROY G. COFFIN has been promoted to an associate professorship of chemistry in the Colorado Agricultural College.

DR. CHARLES H. DANFORTH has been promoted to full professorship in the department of anatomy at Stanford University School of Medicine.

DISCUSSION AND CORRESPONDENCE

WHAT IS WRONG?

ONCE upon a time, a fable tells us, a bull, observing with pleasure the joyous frolics of some frogs, tried with the best intentions to assist in the sport, but the attempt was a failure. The unappreciative frogs cried out—"It may be fun for you, but it is death for us," and the bull withdrew, bewildered and disconsolate.

Some of us, engaged in research in industrial laboratories, may share the disappointment and bewilderment of the poor bull. We study with pleasure, profit and admiration the work of American research men in academic circles. We hope that our work in turn may benefit them, and to that end we freely publish our results. We even try in many ways to give direct assistance. We seek to strengthen the hands of our brother scientists and to earn their good will.

And now we are told by a very able man that we may be swallowing up "the soul of the university" (Dean Barus in the annual report of the president of Brown University, SCIENCE, April 13, 1923). We are crowding with our papers "the programs of the meetings of American learned societies." We are crushing "the incentives to a stimulating competition."

Dean Barus administers his rebuke in delightfully whimsical but earnestly forceful words, and, like the bull in the fable, we pause, disappointed and abashed, and ask—"What is wrong?"

Is there some corporate stigma we carry that makes us unfit companions in the cooperative study of Nature? Are we, too, branded with that "potent cipher," "PAT," which Dean Barus finds marking the trail of "the trusts, as we fondly call them"? The industrial applications of our research may be patented, but we hope the new scientific facts we may discover will be without taint and of benefit to all scientific workers. Are we wrong in that?

Or is it the greater facilities of our laboratories, which, like the bull's avoirdupois, crush competition and overwhelm the professor's soul? If that is the trouble, what is the remedy? If the object of the competition were no more important than a golf championship, the Schenectady putter might perhaps reasonably be barred, as it is barred in England, in the interest of sport, but, in a game in which the object is the increase of human knowledge, an arbitrary limitation of implements would seem too extreme a concession to the sporting instinct. Would it not be better to put the best implements in the hands of all who could use them effectively?

And that, in a modest way, is precisely what we are trying to do. We are not wholly what the Old Soak calls a "mammal of unrighteousness," but if we were, our selfish interests would still insist on our helping academic research as far as we can, since what we, like the rest of the world, most need, and what is far more important to us than material equipment, is men, men with minds trained in scientific methods and filled with a sanely balanced enthusiasm for research. For this prime essential we must look to the universities, and we fully realize that only a vigorous spirit of research in the professor can awaken the spirit of research in the student, and that the spirit of research in the professor can be sustained and quickened only if he and his assistants are given time and facilities for advanced scientific work.

We keenly desire to help. If we are properly advised can we not really help?

Why can not a mutuality of interest and good will be developed between the workers in industrial and academic laboratories? We have tried to hasten such a development. Are we failing? If so, what is wrong?

W. R. WHITNEY
L. A. HAWKINS
RESEARCH LABORATORIES OF GENERAL ELECTRIC COMPANY, SCHENECTADY, N. Y.

AN ANCIENT REFERENCE TO AIRSHIPS

THE suggested existence of airships in early days is found in a book published in 1922 by the Medici Society of London, "The Queen of Sheba and her only Son Menyelek," etc. This book is a translation of the "Kebra Nagast," with introduction by Sir E. A. Wallis Budge; the date of which manuscript Budge assigns to the sixth century, A. D., and the compila-

tion to probably "a Coptic priest for the books he used were writings that were accepted by the Coptic Church" (p. VIII).

The "'Kebra Nagast,' *i.e.*, The Glory of the Kings [of Ethiopia] has been held," says Budge, "in peculiar honour in Abyssinia for several centuries and throughout that country it has been, and still is, venerated by the people as containing the final proof of their descent from the Hebrew Patriarchs, and of the kinship of their kings of the Solomonic line with Christ, the Son of God." The book is "a great storehouse of legends and traditions, some historical and some of a purely folklore character, derived from the Old Testament and the late Rabbinic writings, and from Egyptian (both pagan and Christian), Arabian and Ethiopian sources" (pp. VII–VIII).

The reference to an airship follows the well-known incident of the visit of the Queen of Sheba to King Solomon, who, on the departure of the queen to her own country, gave her, among other fabulously valuable gifts, "a vessel wherein one could travel over the sea and a vessel wherein one could traverse the air (or winds) which Solomon had made by the wisdom that God had given him" (pp. 36–37), thereby, as Budge has pointed out, anticipating "the motor boat and the airship." As ordinary sailing vessels were certainly in use by the time of Solomon it is hardly probable that a vessel of either the galley type or of the sail type would be regarded as of any especially marvelous character. Budge apparently does not note the possible fact that King Solomon understood the construction of artificial lights suggesting modern incandescence, inasmuch as his (Solomon's) house "was illumined as by day, for in his wisdom he had made shining pearls which were like unto the sun, and moon and stars [and had set them] in the roof of his house" (p. 34). All of which would seem to indicate that life in the Solomonic days, save for a certain laxity in morals, was as comfortable and convenient as in the present.

ALICE ALLEN EHRENFELD
UNIVERSITY OF PENNSYLVANIA

A FOURTH CAPTURE IN FLORIDA WATERS OF THE WHALE SHARK

ABOUT 11 o'clock on the morning of June 9, 1923, as Mr. Claude Nolan, of Jacksonville, Florida, was cruising with a party of friends in the Florida Keys near Marathon, sixteen miles below Long Key, a gigantic shark was seen. This was secured by two harpoons by Captain Newton Knowles, who later fired into it fifty or sixty shots from a 30–30 rifle. The giant fish did not offer much resistance and by the afternoon it was so far subdued that it was towed by a house-boat and two guide-boats to Long Key, where it was tied up to the dock about 11 P. M. The fish remained alive until some time the second day, following, about fifty-four hours after it was harpooned.

Mr. L. L. Mowbray of the New York Aquarium by great good fortune was in Florida at this time. He had gone to Nassau, Bahamas, to install an aquarium there, but, finding the water in the harbor fouled by the dredging going on, left for Miami, where he arrived on the morning of June 9. Early the next day, hearing of the capture of a "huge monster" at Marathon, he took the first train for Long Key, and at once identified the fish as the whale shark, *Rhineodon typus*.

Mr. Nolan with great generosity presented this giant shark to the American Museum, and Mr. Mowbray at once wired the authorities. A member of our department of preparation left at once for southern Florida with orders to save the skin and all the hard parts possible. In the meantime Mr. Mowbray had advised that there were no facilities for handling the shark at Long Key and urged that it be towed to Key West. This was accordingly done, the start being made June 13, and the fish arriving at Key West at 4:30 P. M., June 14, much mauled by the attacks of tiger sharks on the way.

Unfortunately a wave of unprecedented hot weather struck southern Florida at this time, and the water in Key West harbor reached the unheard-of temperature of 91.4° F. This, aided by the fact that some of the fins had been torn off and the abdomen badly lacerated by sharks, produced rapid decomposition. The outer skin sloughed off, the internal organs were thoroughly macerated, and even the solid masses of thick, muscular tissue were in such condition as to call for immediate action. It was impossible to save the skin, but various hard parts were preserved in brine and brought to New York. We have parts of a tooth band, the cartilages of both jaws, the occipital part of the skull, a number of vertebrae, and parts of the claspers, and, in addition, sections of the skin.

Mr. Mowbray fortunately made a sketch of the shark and a set of careful measurements, and wrote out an exact description, noting position, size and shape of fins, coloration, etc. From these data a 63-inch model is now being constructed by our department of preparation. This will be molded and colored in accordance with Mr. Mowbray's notes, and can serve as a basis for building a life-sized model for our new hall of fishes. The fish was 31.5 feet long, 23 feet in greatest girth, and had a vertical spread of caudal fin of 12 feet. Mr. Mowbray and the writer plan to write for the *Bulletin* of the American Museum a fuller article on this specimen, illustrated by photographs of the fish and of the completed model.

This is the fourth specimen of Rhineodon recorded from the Florida coast, and the fifth in the Atlantic

Ocean. The first specimen, 18 feet in length, came ashore on Ormond Beach in 1902. The second, a 38-foot specimen, was taken by Captain Charles Thompson of Miami and Mr. Charles T. Brooks of Cleveland, Ohio, in May, 1912. The third (31 feet long) was captured by Dr. H. Schlegel and others in the Bay of Florida, June 10, 1919, and the fourth (31.5 feet between perpendiculars) is the present specimen. The fifth record for the Atlantic is the specimen (about 30 feet long) rammed by the steamship *American Legion* in May, 1922, near the Abrolhos Light off the coast of Brazil, and noted by me in SCIENCE, 1922, Vol. 66, pp. 251–252, and in *Natural History*, 1923, Vol. 23, pp. 62–63.

E. W. GUDGER

AMERICAN MUSEUM OF NATURAL HISTORY

QUOTATIONS

MEDICAL RESEARCH

SIR,—In your issue of the 7th a patient points out in a very vivid letter the benefits, dangers and costliness of insulin in his own case of diabetes. He shows clearly that it is impossible to continue its use indefinitely, and when discontinued that the diabetes returns with death as the unavoidable result. This demonstrates conclusively the need for one thing—the discovery of the real cause of diabetes, and this can only be attained by experimental research.

The key to the discovery of insulin was Minkowski's demonstration in 1905 that every dog from which the pancreas (the sweetbread of our dinner table) was removed died of diabetes. Evidently there was something in the pancreas which prevented the disease. Banting and Best discovered that something. But that discovery still leaves us in the dark as to what is the disturbance of nutrition—the metabolism of the body—which prevents the burning up of the sugar in the blood. This accumulation of sugar inevitably causes death, slowly in most adults, swiftly in children.

It is perfectly evident to any open-minded person that the discovery of the cause of this disturbance of the nutrition in the body cannot be made simply by clinical observation on man. It can only be obtained by experimental research on animals. This is a duty imposed upon our research workers. Any obstacle put in their way is deliberate cruelty to human beings, and not to a small number of human beings, but to a very large number, especially of children.

When the alternative of experimenting on animals or of allowing multitudes of human beings to die of diabetes is presented to any unprejudiced mind, there can be but one answer. The lives of human beings are of infinitely more value than those of animals. Moreover, once the cause is discovered, the lives and happiness of human beings and their families are conserved for all future time. The sacrifice of a relatively few dogs sinks into insignificance in comparison with the lives and happiness of multitudes of human beings.—*W. W. Keen, in the London Times.*

SCIENTIFIC BOOKS

A classification of fishes including families and genera so far as known. By DAVID STARR JORDAN, Chancellor Emeritus of Stanford University. Stanford Univ. Publ. (Biol. Sci.), Vol. 3, No. 2, 1923, pp. 79–243, i-x.

UNTIL the appearance of the work cited, ichthyologists had long waited for a comprehensive classification of all the known genera and families of fishes. Not since the publication of Günther's "*Catalogue of the fishes of the British Museum* (1859 to 1870)" had any one attempted to supply this need. The work of Günther had been a long and tedious one, having required for its completion a considerable part of the lifetime of one of the most laborious of systematic zoologists. Furthermore, the knowledge of ichthyology had since that time been greatly widened in many ways.

The task of preparing a new classification year by year had thus become increasingly large and difficult: so much so, in fact, that Dr. Jordan alone among living workers possessed a knowledge of the literature of ichthyology which was sufficiently comprehensive and an acquaintance with the fishes of the whole world intimate enough to permit of the preparation of such a work.

In this latest classification, fishes, living and extinct, are arranged under six classes: Leptocardii, Marsipobranchii, Ostracophori, Arthrodira, Elasmobranchii and Pisces. The "true fishes" are further divided into three subclasses: Crossopterygii, Dipneusta (Dipnoi) and Actinopteri. The Actinopteri are made to include the superorders Ganoidei, Teleostei and Acanthopterygii (the author, however, certainly did not intend to remove the group last named from nor to coordinate it with the Teleostei). The teleost fishes are divided into no fewer than 39 orders, the increase being largely accomplished by the elevation of various groups, largely the serranoid derivatives, from subordinal to ordinal rank.

Space will not permit of the discussion, or even an outline, of the limits and positions assigned to these various groups. As a whole Dr. Jordan has followed recent suggestions regarding the status of the major groups of fishes.

There is widely used throughout the work, particularly among the "higher" fishes, a group termed the *series.* Usually but not consistently the names of series are formed by adding the suffix *-iformes* to the root of the typical genus of the group. In most cases

the series are used as strictly or approximately coordinate with suborders, but once a series (Ostariophysi) is used to include several orders, while in a few instances series are subordinated to suborders.

The most striking taxonomic feature of the whole work—one which will appeal to many systematists as radical—is the extreme multiplication of family divisions. In all, the fishes are divided into 638 families; the teleosts alone are split into 511; the current group Cottidae, to take an example, is analyzed into 12 families. The increase in the number of families has been brought about by the entire elimination of subfamilies, those less sharply marked being merged together, those more clearly defined elevated to family rank.

This minute division of fishes into families is justified by the statement, often used by the author, "that analysis must precede synthesis." It must be remarked, however, that in actual practice analysis seldom has led to synthesis. To use more familiar terms, "splitting" leads to further "splitting," not to "lumping."

It seems impossible to arrive at any conclusion as to whether this multiplication of families is or is not justified. There is no known clear-cut criterion by which to decide whether any natural assemblage of genera should be called a subfamily or a family, or a "series" or suborder. There is, as indeed the present work strongly suggests, a very large if not a preponderating element of the subjective in the estimation of taxonomic rank.

Under each family the pertinent generic names, with authorities and dates, are listed chronologically. With each name is given a page reference to "The genera of fishes," which was published by the same author, in four parts, from 1917 to 1920. That work and "A classification of fishes" will for many years be two of the most used of any works in the libraries of systematic ichthyologists.

CARL L. HUBBS

UNIVERSITY OF MICHIGAN

SPECIAL ARTICLES

BLACKENED SPHERES FOR ATMOMETRY

SINCE the time when spherical, white, porous porcelain pieces first became available for use in the study of evaporation as one of the influential environmental conditions affecting organisms, it has been clear that black, porous spheres, as well as white ones, are much needed in ecological and physiological instrumentation. Two porous-cup atmometers operating side by side, one equipped with a white and the other with a black sphere, the two spheres being practically alike in all respects excepting as to their ability to absorb radiation, constitute what I have called a radio-atmometer. Rates of water loss from the black member are greater than the corresponding rates of loss from the white during periods of illumination, while both members lose water at the same rate in darkness. The difference between the two rates for any period constitutes a valuable index of the intensity of radiation for that period. The radio-atmometer has already established itself as a valuable instrument in the hands of research workers interested in natural solar radiation as the latter influences the growth of plants, and especially as it accelerates the rate of water loss from their foliage.

Although a supply of rather satisfactory black, porous porcelain spheres was secured several years ago, the supply has recently become exhausted and it will probably be a number of months before another supply will become available, for serious difficulties are encountered in the making of these black pieces. In the *interim* I have tried several proposed methods for blackening the ordinary white spheres. The black materials that can be readily applied to such pieces are subject to removal by the action of rain or else, if they adhere well, they often tend to reduce the water-permeability of the porous porcelain. I have recently employed a coating of lampblack with excellent results in instrumentation wherein rain is not encountered. For rainless periods in the open and for greenhouse studies, these lampblackened spheres are more satisfactory in operation than are any black porcelain spheres thus far secured. The purpose of this note is to bring this simple blackening of the white spheres to the attention of those who wish to employ radio-atmometers for studying solar radiation, etc., in exposures where rain does not occur or for periods without precipitation.

Commercial lampblack is first thoroughly washed by repeated boiling in distilled water, the liquid being thoroughly stirred as it boils. After each boiling it is allowed to settle and most of the water is decanted off, a new supply of water being then added for the next boiling. Four or five boilings and decantings result in a material that settles readily in water and exhibits no oily film. The washed lampblack is preserved under distilled water in a stoppered bottle. It is applied to the porcelain sphere, after the latter has been filled and set up for operation, by means of a small camel-hair brush. The excess of water enters the sphere, leaving a uniform layer of wet lampblack on the outer surface. The black coating remains wet with the highest rates of evaporation and the most intense sunshine, it does not significantly alter the evaporation coefficient of the sphere, as far as conditions other than radiation are concerned, and it acts very satisfactorily as an absorber of radiation. The sphere should be cleaned and recoated about once a week—or oftener if the prepared surface is accidentally in-

jured, as by the innocent fingering of the ubiquitous meddling visitor or by rain. Cleaning is accomplished by holding the sphere under a trickle of distilled water while scrubbing it thoroughly with a brush. The white sphere should of course be cleaned in the same way at the same time (employing another brush, free from lampblack!).

Blackened spheres thus prepared and treated have held their coefficients for several months and they should hold them indefinitely. Their rates of water loss are the same as those of the best black porcelain spheres similarly exposed. In the open the hourly rate of water loss from the white sphere may be as great as 9 or 10 cc. (for the hottest part of a dry summer day at Tucson), while the corresponding rate of loss from the black or blackened sphere may be as great as 11 or 12 cc. In the open at Baltimore, in July, the white sphere loses from 30 to 60 cc. per day and the blackened one loses about 16 cc. per day more than the white one, for the clearest July days. The daily index of solar radiation for clear summer days is about 18 cc. for Tucson and about 10 cc. for Baltimore. For the greenhouse at the latter station the average daily radiation index for January is about 1.2 cc., for July about 4.0 cc.

In this and related lines of experimentation I have been ably assisted by Mr. J. D. Wilson, of this laboratory.

Burton E. Livingston
Laboratory of Plant Physiology,
The Johns Hopkins University

REFERRED SENSATIONS CAUSED BY STIMULATION OF THE INTEGUMENT IN NORMAL GUINEA PIGS

Though the curious reflexes which tactile and pressure stimuli of the integument elicit in the normal guinea pig[1] were clear and unmistakable in their expression, yet their tentative explanation proved highly unsatisfactory until a chance observation in this study gave the clew. It was then realized that many of these responses were not the immediate answers to the original stimulus but were the result of a referred, perhaps centrally radiated, sensory impression which the primary tactile or pressure stimulus had called forth. A few experimental results will illustrate this statement.

When the skin covering the right costal margin is gently rubbed with the rounded end of a slender wooden rod, the animal being free in a spacious box, then under proper conditions the animal sooner or later swiftly wipes the right front foot backwards once or twice, the toes being spread apart. Repetition of the stimulus then causes a very rapid shaking of the foot back and forth; on further stimulation the right front foot is lifted and the animal seizes the nail of the inner toe with its teeth and pulls vigorously; at times it may seize all four front toe-nails in rotation and strip them with its teeth. Stimulation on the left costal margin causes the same reaction with the left foot. Not infrequently a crossed response to the stimulus is observed: stimulation of the right costal margin calls for the reaction in the left foot or vice versa.

Pressure stimuli applied to *one lumbo-pelvic area* may cause some or all of the following responses: lateral arching of the body, the head approaching the site of stimulation; repeated rapid seizure of the hair at the point stimulated by the lips and teeth as if seeking a parasite; the mirror picture of the above, the animal seizing the hair at the symmetrical point on the opposite, non-stimulated side; the lateral aspect of the jaw on the side stimulated is vigorously scratched by the hind leg; the ear, top of the head and the lateral aspect of the jaw is wiped repeatedly by the front foot of the stimulated side, the head being rotated so that the nose is turned towards the non-stimulated side; the wiping movement is repeated by the front foot of the opposite side or the animal may sit up on its haunches wiping the top of the head, the ears and jaws simultaneously or alternately with its front feet.

Another example of dyschiria is seen when the sacro-pelvic portion of the back is stimulated by repeated tactile stimuli (bristle): the perineal region is suddenly depressed and moved forward on the floor, or occasionally both hind legs are extended forwards and by means of its front legs the animal walks forwards, scraping the perineal area along the floor.

An instructive series of motor responses apparently due to a related shifting of referred sensory impressions may be seen when the animal is examined in a small box whose floor and sides are formed by half-inch wire netting; the box is supported at each corner by columns 7 inches high, the bases also support an inclined mirror which permits easy observation of the animal's ventral aspect. Repeated stroking of the sole of the right hind foot with the tip of a wooden rod may cause all or some of the following reactions: the right hind leg is first lifted abruptly and set down with a stamp; on continuation of the stimulation the same leg is again suddenly extended forwards, and one nail of the toes, or all of them in rotation, are seized by the teeth and vigorously pulled; the stimulation being continued, there may be only a slight or no movement of the stimulated right hind foot, but the right front foot is lifted and one or more toe-nails seized and pulled; still later a crossed response is obtained and now the left hind leg is extended forwards and the toe-nails seized and pulled

[1] John Auer, Science, 1923.

by the teeth; still later, the stimulation of the right sole being continued, the animal scratches the right shoulder with the hind leg.

The impulses caused by tactile or pressure stimuli of the integument are not only referred to other skin areas, they may be referred to mucous membranes. For example, after tactile stimulation of one, the animal may suddenly rub the same or the opposite or both sides of the nose with circular movements of the radial aspect of the fist or fists. There are also sneezes and in two instances drops of milky fluid suddenly issued from a naris (nares?). Furthermore, slow, chewing motions of the jaws are very common after tactile stimulation of the skin. At times the animal seizes and chews anything available in the neighborhood: sawdust, hay, the wooden sides of the container or the netting itself. The wide opening of the jaws occasionally observed may possibly also be associated with a type of sensation referred to the buccal cavity.

In addition to these manifestations there is evidence that at least one of the special senses apparently may be involved. When an animal is tested with tactile or pressure or both types of stimuli, one may see that the animal suddenly pauses, raises its nose high in the air and samples it in various directions; or the animal abruptly sniffs interestedly in the sawdust, often spreading the sawdust by lateral sweeps of its front legs to facilitate its olfactory investigation.

It is believed that these observations may be of value in aiding the interpretation of other normal and abnormal reflex activities.

JOHN AUER

ST. LOUIS UNIVERSITY
SCHOOL OF MEDICINE

THE KENTUCKY ACADEMY OF SCIENCE

THE Kentucky Academy of Science held its tenth annual meeting on May 12th at the University of Kentucky, Lexington. The session was called to order at 9:30 o'clock by President Beckner.

The secretary's report showed 149 members, including 65 national members, 48 local members, 23 corresponding members and 13 honorary members. Thirty-five new members were elected.

Resolutions were passed unanimously agreeing with the resolutions adopted by the council of the American Association for the Advancement of Science with reference to their position on organic evolution. The Academy voted to hold a symposium on evolution at a meeting in Louisville, the date for which is to be determined.

The officers elected were:

President, Dr. W. R. Jillson, state geologist, Frankfort.

Vice-president, Dr. Austin R. Middleton, University of Louisville, Louisville.

Secretary, Dr. A. M. Peter, Experiment Station, Lexington.

Treasurer, Prof. W. S. Anderson, Experiment Station, Lexington.

Representative in the Council of the American Association for the Advancement of Science, Dr. A. M. Peter.

The program included an address by Dr. E. N. Transeau, head of the department of botany, Ohio State University.

The following program was rendered:

Eastern Kentucky's sea shore: LUCIEN BECKNER. The ancient shore line was described as parallel, generally, with the axis of the Cincinnati anticline and to the east of it. The general thickening of the strata eastward, with increasing distance from the shore line, was pointed out and evidence was cited of the presence of estuaries of great rivers. A very peculiar and interesting feature of the geology (stratigraphy) of Eastern Kentucky was shown by a vertical cross-section of the rock formations, extending from Lee County into Pike County, constructed by plotting well records graphically. The section shows that the deeper rocks (Devonian) continue their eastward dip into Pike County, but that this is not the case with the surface formations.

Jeptha knobs of Shelby County: WALTER H. BUCHER. The geological structure of Jeptha Knob was described as that of an upthrown fault block. The formations of which the knob itself is composed were described as horizontal and of Ordovician age. On either side of the knob evidence of faulting was observed. It was inferred that only the area included by the knob was affected by the upward movement.

The Haddix-Coalburg geosyncline: W. R. JILLSON. A study of the profile of the Haddix-Coalburg geosyncline (plotted by the writer to scale) brings out clearly for the first time the following facts: (I) This geosyncline is divisible into three units: (1) Kanawha River westward to Tug Fork, low elevations between 580 and 540 feet; (2) Tug Fork southwestward to Middle Fork of Kentucky River in Perry County, low elevations between 855 and 580 feet; (3) Middle Fork of Kentucky River to Jellico region (Tennessee line), lowest elevation 855 feet and highest elevation 1,600 feet. (II) Regional coincidence of pronounced structural highs in Floyd and Clay Counties with important developed gas fields, and lack of coincidence with large and important developed oil pools in all of its course until the Cabin Creek region of southern Kanawha County, West Virginia, is entered. (III) Coincidence of synclinal structure with all lines of major drainage from the South Fork of the Kentucky River northeastward to the Kanawha River.

Land of ten thousand sinks: W. R. JILLSON. The pitted or sink-hole characteristic of the St. Louis, Ste. Genevieve and Chester divisions of the Mississippian System in Kentucky has long been recognized. The widely ramifying sub-surface drainage developed in these limestone rocks, which are frequently of high purity, is well exemplified in the karst and cave region of Edmonson

County, Kentucky, and in the natural sewage channels of the City of Bowling Green, Warren County, Kentucky. The peculiar topographic figure of the "sink" country is well shown on either side of the Louisville and Nashville Railroad, and the Dixie Highway from Munfordville in Hart County to Bowling Green. The recently completed Mammoth Cave topographic sheet exhibits 2,833 sink-holes, and is regarded as a model for students. The number of sinks on other completed quadrangles follows: Brownsville 1,150, Bowling Green 2,563, Princeton 1,429, and Monticello 1,096, giving a total of 9,071. The Brownsville topographic sheet shows the largest mapped sink-hole, just south of the Dripping Springs escarpment, between Girkin and Tuckertown postoffices. This gigantic sink has an area of 4.865 square miles or 3,114 acres. It is estimated on a basis of mapped areas that the Mississippian plateau in Kentucky contains between sixty and seventy thousand sink-holes of varying size and description.

A gigantic slate slide: W. R. JILLSON. The largest and most destructive "slate slide" in the history of mining operations in Kentucky occurred at Burdine, Letcher County, on the waters of Elkhorn Creek, adjoining the northwest flank of Pine Mountain, on February 3, 1923. About 360 cubic yards of "slate" taken from the parting of the Elkhorn coal (Pottsville) at Mine No. 201 of the Consolidation Coal Company and gobbed in Slate Hollow became supersaturated with rainwater and wash during an abnormal precipitation of 3.27 inches for the 48 hours immediately preceding the slide. The direct causes of this slide were: (1) Abnormal precipitation combined with inadequate sub-slate drainage; (2) unstable angles of rest (35°) on the breast of the fill; (3) excavation and ditching operations following the first minor slips; (4) seismological disturbances of record, and (5) unusual regional geotectonic relationships. The total length of the slide was 929 feet. The semiliquid "slate" moved out fan-shaped entirely across the bottom of Elkhorn Creek to a maximum depth of 75 feet. The movement was entirely within the "gobbed" slate and did not affect the underlying country rock or soil. Casualties were narrowly avoided.

The largest fort of the mound builders in the knobs of Kentucky: WILBUR GREELEY BURROUGHS. The fort is in Madison County, Kentucky, 3½ miles southeast of Berea, on the flat top of a mountain, 620 feet vertically above the surrounding valleys. It covers about 250 acres. Rough stone barricades guard each of 13 possible approaches and cliffs 100 to 180 feet high form the other sides. Even certain accessible joint planes four feet wide are barricaded with regularly laid rough stone walls. Piles of stone "ammunition" occur at intervals. The author made the first detailed survey and explored this fort in 1922–23 for the State Geological Survey. With voluntary assistants he has excavated in the caves and rockhouses of the fort in search of remains of the prehistoric people.

The social significance of psychological tests for college students: J. B. MINER. Three statistical pictures of the results of the Army Alpha test conducted at the University of Kentucky were presented. The first shows how closely the scores of the freshmen parallel the distribution curve of the officers in the American army. This indicates the high type of individual which the university has to train and the importance of clear recognition by the student body that it is fitting itself for positions of leadership and responsibility. The second compares the seniors with the freshmen in the College of Engineering. It furnishes a start towards the problem of defining the minimum essential of intellectual capacity necessary for completing the engineering course. The third shows tests of the twelve Kentucky candidates for the Rhodes Scholarship in the recent award. The results corroborate the opinions of the committee which made the selection after an elaborate comparison of the personal histories and the scholarship records of the candidates, supplemented by a half-hour interview with each man. It shows strikingly that high records on the psychological tests are correlated with the sort of personal characteristics sought in making this appointment.

Notes on the constitution of benzene: C. C. KIPLINGER. The author attempts to prove that Kekulé's vibration hypothesis, with a slight modification, is still as fruitful in affording explanations of the chemical behavior of benzene and related structures as the more complex hypotheses of later development. It is a fallacy to expect two ortho di-substitution products of benzene, since these could be but two special phases of the vibration cycle of a Kekulé molecule, which cycle probably occurs very rapidly. The Thiele molecule becomes a special phase of this cycle. The structures of naphthalene and anthracene are discussed briefly along the same lines. The paper is speculative and presents no new experimental evidence.

Ulcerative cloacitis in chickens: M. SCHERAGO. This is either a rare disease in Kentucky or it is not readily recognized by the poultryman. If the latter, the number of cases must be very few and the disease itself of little importance. The rather sporadic occurrence of ulcerative cloacitis in a flock and failure to transmit the disease to healthy fowls seem to indicate that it is not contagious and is not transmitted by coitus. Birds affected may be treated with a single cleansing of the anal region and cloaca and one or two applications of a 1–1000 solution of mercuric chlorid; they recover without further treatment. An attack of this disease does not seem to affect the future laying capacity of the hen.

Effect of developing fetus on production of milk of dairy cows: J. J. HOOPER. Records of 24 cows studied indicate that the growing fetus, five or six months after conception, exerts a decided influence in checking milk secretion of the mother cow. When left unbred for most of the lactation, cows maintained a higher milk yield during the last months than when bred early. The author infers that the six-months' old fetus secretes something that dries off the cow preparatory to rest and calving.

Market milk—free from B. Coli: E. J. GOTT and L. A. BROWN. The Public Service Laboratories of the Kentucky Agricultural Experiment Station have made a B. coli count as a routine procedure in the examination of milks for the past eleven years. In order to determine if market milk was absolutely free from members of the

B. coli group, 5 to 10 cc. portions of a number of samples of milk were incubated at 37½° C. for 18 to 24 hours. Out of 87 samples the authors failed to obtain B. coli in 31, or 35 per cent. Forty original pints and quarts of milk from two dairies were incubated one day at 30° C. and the next day at 37½° C. After the final incubation, thirty-one (77 per cent.) were found to be free from members of the B. coli group. It is possible for dairymen to produce milk free from B. coli. The B. coli count is of distinct advantage in the sanitary scoring of dairies and dairy products.

Association of manganese with the so-called vitamins: J. S. McHargue. The author presented further data which confirm his previous conclusions that manganese is an essential element for plant growth and has a function in the synthesis of chlorophyl. Data were presented which show that in the modern process of milling rice, barley, wheat and corn, the greater part of the manganese contained in the pericarp and germ is removed in the offal when these cereals are prepared as highly milled products for food. Analyses were presented which show that in the animal body manganese occurs in the largest amounts in the liver, kidney, pancreas, heart and brain. Since these organs are also richest in vitamins the author concludes that manganese is in some way responsible for the presence of the vital factors in these organs. It was also shown that egg yolk contains an appreciable amount of manganese, whereas the white of the egg contains no manganese—a fact in harmony with the observation that the yolk of eggs contains vitamins, whereas the white is deficient in vitamins. Similar parallelisms were shown in cod livers, cod liver chum and refined cod liver oil; also in tomatoes, oranges and lemons. The author concludes that manganese is closely associated with vitamins and is responsible for the origin of the vitamin factors in some way as yet undetermined, probably catalytically.

The occurrence of two fern rusts in Kentucky: Frank T. McFarland. So far as the writer has been able to learn, no rusts of the Pteridophytae have ever been reported for Kentucky. While on a collecting trip to Cumberland Falls the writer found several patches of Pteridium aquilinum (L.) Kuhn bearing rust sori. On examination this rust proved to be Uredinopsis pteridis Diet. and Holw. Collected at Cumberland Falls, Kentucky, August 31, 1922. While the writer was working in the university greenhouse the first day of December, 1922, his attention was attracted by some whitish spots on the under surface of the leaves of a potted Pellaea atropurpurea (L.) Link, fern. Cross sections of these spots revealed a rust known as Hyalopsora cheilanthis (Pk.) Arth. No teliospores were found in either collection. Specimens are in the writer's herbarium and that of the University of Wisconsin.

A method of demonstrating seed infection in supposedly disease-free corn: W. D. Valleau. Comparative ear-to-row tests of heavily infected and so-called disease-free corn have indicated that yield will not be increased by the selection of ears which appear freest from infection. Seed from ears which appear freest from infection show, when grown in sterile sand a sufficient time, definite evidence of being infected internally with fungi. A microscopic study of serial sections of corn seeds which appeared disease-free when cultured in agar often showed extensive development of hyphae between any parts of the pericarp and seed-coat walls. In seeds which appeared to be free from infection for long periods in the sand box the hyphae were found to be extremely small and less extensive but always present in the seeds examined. It is concluded that negative evidence obtained by petri plate or test-tube cultures of corn seeds are valueless as an indication of freedom from fungi.

Late frost injury to some trees in the Bluegrass Region: A. F. Hemmenway. The Easter freeze of 1921 injured the woody tissue of several kinds of shade and fruit trees in this region. The writer has examined three conifers, twelve deciduous shade trees and twelve varieties of fruit trees. The Transcendent crabapple, Black Tartarean cherry, linden and hard pines were most noticeably injured. The injury is more severe in twigs less than five years old. Twigs injured by frost may render the tree much more susceptible to attacks by fungi.

The Hydnaceae of Kentucky: G. D. Smith. The occurrence of the following species was noted and colored lantern slides representing one or more forms of each were shown and explained. Hydnum repandum, Linn.; Hydnum coralloides, Scopoli.; Hydnum imbricatum, Linn.; Hydnum albonigrum, Pk.; Hydnum adustum, Schw.; Hydnum caput-ursi, Fr.; Hydnum erinaceus, Bull.; Hydnum caput-medusæ, Bull.; Hydnum septentrionale, Fr.; Hydnum zonatum, Batsch.; Hydnum putidum, Arkinson.

The postglacial history of the vegetation of Ohio (Lantern): Edgar N. Transeau. Presenting results of studies of the influence of the Glacial period on the vegetation of Ohio, pointing out the fact that during glacial times much of Ohio was covered by an ice cap and that the distribution and character of the present ultimate or climax flora is not so much due to influences coming from geological formations, from soils or from moisture conditions, as from a migration of plants that followed up the ice as it disappeared. The vegetation now consists largely of plants derived from a few outside centers of dispersal, a southeastern, roughly represented by the Allegheny Mountain region, a western prairie center from which many plants have come in by way of the western end of the state, and a boreal center, the latter during the Glacial period being pushed southward and now furnishing a few species, remnants of those that during the Glacial period hung on the flanks of the ice and followed it up as fast as it retreated. Some of these plants are still to be found in isolated and protected spots. The lecture was highly appreciated by those present because of its bearing on the flora of Kentucky, a region which was profoundly influenced by the same conditions, though only touched by the ice sheet. The vegetation of the state, it had been noted, was derived largely after Glacial times from the centers that have furnished most of the plants of Ohio; for while its surface was not as greatly affected by the ice, its climate and such vegetation as existed must while the ice remained have been decidedly boreal in character.

Alfred M. Peter

SCIENCE NEWS

HOW TO OBSERVE THE COMING ECLIPSE OF THE SUN

Science Service

EVERY one can have the thrills of an astronomer during the coming eclipse of the sun on Monday, September 10.

This great astronomical event will be visible in its partial phase in all parts of North America, and although the darkening will be total in only a small part of California and Mexico, the amateur can make many observations at home without the trouble of traveling to this area.

Amateur observations, like those of professional astronomers, can be both visual and photographic.

Plan your program carefully in advance of the eclipse time. Pick out a location from which the sun will be easily visible and where no smoke, dust or clouds are likely to obscure the spectacle.

Dozens of crescent suns can be observed if you will look under shady trees and on tree shaded walls while the eclipse is in its partial phases. These images, with the horns of the crescents turned in an opposite direction to those of the sun above, have a striking appearance. Tiny holes in the leaves act as lenses, as they do in pin-hole cameras, and form the images with the ground or wall as a screen. In ordinary times when the sun's light is not in conflict with the moon, the sunlight filters through the leaves in a series of tiny, overlapping disks on the ground, each round since it is an image of the sun. In photographing the crescent images of the eclipse period, an ordinary snapshot exposure with a large stop in the lens may be used. These exposures should be developed full time. Because of the fact that the images obtained with ordinary hand cameras will be quite small, it is recommended that enlargements be made and these enlarged pictures should prove very attractive.

For observing the sun directly, the old and tried method of smoking a piece of glass over a fish-tail gas jet or with a candle will prove satisfactory. This smoked glass should be prepared before the time of eclipse so as to obtain a carbon coating of proper density. Dark spectacles will be popular with those who do not wish to get their hands dirty. A photographic film or plate that has been exposed to light and developed can also be used.

With such eye shields it will be possible, by beginning observations a few minutes before the predicted time of eclipse, to check up on the actual time that the moon first infringes on the sun's disk. The magnitude of the eclipse, or the amount of the sun's diameter that is covered by the moon can also be estimated through the protectors and also the time that the moon passes off and ends the eclipse should be noted. A drawing of the sun showing the location of the points at which the eclipse began and ended would be an interesting record.

The eye strain of looking directly at the sun can be obviated by using the pin-hole method of observation. A hole is punched with a fine needle through a piece of cardboard or dark film and a smooth white card is used as a screen. The needle-hole acts as a lens since it is so small. Rays from opposite edges of the sun pass each other in going through the hole and the result is a perfect image of the sun on the cardboard screen that can be enlarged if desired with a small magnifying glass. This simple apparatus can be constructed and tried out on the uneclipsed sun.

To get the most effective and interesting photograph of the partial eclipse, a series of exposures should be made at intervals of say five minutes covering the duration of the eclipse. For this the camera should be placed on a tripod, the legs of which are arranged so that the camera points upward sufficiently to show the image of the sun in the upper right corner of the Kodak finder. All preparations should, of course, be made before the eclipse starts.

In localities where the eclipse starts with the sun low enough in the sky, it would add to the pictorial value of the picture to include the horizon line in the picture area. As to exposure, it is suggested that the smallest stop be used in the lens and that the shutter be set for the fastest speed. Then make one exposure every five minutes without turning the film for the duration of the eclipse. A single exposure can, of course, be made of the eclipse, in which case, the camera can be held in the hands, but a succession of images at equal distances apart will make a more effective showing.

A color filter would aid in preventing overexposure if the day is unusually clear, and the atmosphere free from haze. No change should be made, however, in the stop and shutter speed combination mentioned above, even if a very deep colored filter, such as the "G," is used on the lens. In place of the filter a piece of film that has been flashed to light and developed to a good density could be used in front of the camera lens to prevent overexposure. It is also recommended, that if the sun is not obscured by clouds, that the time of development be reduced to one half of that which would be given normally.

Where the eclipse is total, however, the camera should be placed on a tripod and a succession of exposures of 2, 5, 10, 20, 40 and 60 seconds made, the film being wound a complete turn of the winding key between each exposure. A filter or piece of film need not be used in front of the lens when photographing a total eclipse. Such a series of exposures just mentioned should give interesting studies of the eclipse and the sun's corona. The corona can neither be seen nor photographed except where the eclipse is total. A record could be obtained with a pin-hole camera, but to make a really successful camera of this sort requires a little knowledge of photography and would necessitate some previous experimenting as to exposure time.

The common box camera equipped with lens and shutter will make excellent pictures. Motion-picture cameras could be used, exposing at intervals several feet of film during the partial eclipse and cranking continuously during the several minutes of totality. An amateur motion-picture camera, like the new Cine-Kodak, could be used.

GIANT FOSSIL REPTILE TAKEN TO CAPITAL

Science Service

DIPLODOCUS, the gigantic eighty-five foot long reptile which over eight million years ago waded through the swamps of what is now Utah, has just arrived in Washington. Dr. C. W. Gilmore, paleontologist of the U. S. National Museum, has reached here with the twenty-five tons of sandstone and fossil remains of this monster which were chiseled from the cliffs near Vernal, Utah, and hauled 152 miles across the mountains to the railroad.

Five years will probably be required to free the fossilized bones from the stone in which they are imbedded and mount the huge skeleton in the position in which it probably stood when alive. When completed it will be made the central feature of one of the large halls of the museum.

Some eight to twelve million years ago, this fossil creature was alive from the end of its slender tapering tail to the top of its head on its long neck and stood fourteen to sixteen feet high at the hips. It could stand in water forty feet deep with its feet on the bottom and thrust its head above the surface. It is estimated that alive and in its skin it weighed from sixteen to eighteen tons.

Since its time, rocks have been laid down burying the lagoons and swamps in which it lived some 10,000 feet below the most recent strata. The forcing up and folding of the layers of rock to form mountains brought these ancient rocks up to where the fossils were found, a locality set aside some years ago as Dinosaur National Monument and from which the Carnegie Museum of Pittsburgh has taken many specimens of the same species.

What were once low swamps have been raised during the ages to 4,000 feet above sea level. After cutting the fossils and their surrounding sandstone from the cliff, the twenty-five tons of material representing the remains of this swamp-living creature were carried 5,000 feet higher to get them across the mountains to the railroad 152 miles away.

One of the seventeen vertebrae of the neck of the diplodocus was three feet long, while one of the pelvic bones weighed, as boxed, nearly 2,000 pounds. For shipment the fossils were roughly hewn out of the stone, and much careful work will be required to remove the remaining rock from around the fossilized bones.

THE "DEVIL'S GRIP"

Science Service

"DEVIL'S GRIP" is an infection but the elusive germ that does the work is still at large. This sums up the status of the inquiry into the cause of this strange disease now prevalent in Virginia, as reported by Dr. George C. Payne, epidemiologist of the Virginia State Board of Health, and Charles Armstrong, past assistant surgeon in the United States Public Health Service.

The epidemic appears to be confined to rural communities and to be spread within families by contact. Children are more frequently attacked than adults. The symptoms point to an inflammation of the surface of the diaphragm and the disease might be called, technically, epidemic transient diaphragmatic spasm, and is quite possibly related to some of the other infectious conditions which follow the epidemics of influenza.

The condition was first reported by Dr. Maud M. Kelly, of the State Board of Health, of Virginia last month. She had seen a number of persons in Hanover County who had recently suffered from an illness characterized by an acute onset, with abdominal pain but without the usual history of summer digestive disturbances. On July 21, similar cases were reported in Carolina County and since that time they have appeared throughout the northeastern part of the state. Cases have been reported by thirty-eight physicians from twenty-two counties. A similar disease appeared in Virginia in 1888 and was described by Dr. W. P. Dabney under the name "Devil's Grip." His paper was called, "An account of an epidemic resembling dengue which occurred in and around Charlottesville and the University of Virginia in June, 1888." The attack comes on suddely with severe abdominal pain which later extends to one or both sides of the lower part of the chest cavity. Breathing is difficult and rapid. The temperature rises in practically all cases and there is intermittent pain. Most of the patients perspire freely. The pain is increased on movement and in some cases by swallowing. In general, the patients are constipated, but the condition is followed by diarrhoea. Most of the patients complain of headache and pain in the back. After from four to ten hours of severe pain and difficult breathing, the condition begins to subside, but there may be relapse. Most of the patients recover without any secondary complications.

INFANT MORTALITY AND ITS CAUSES

Children's Bureau, U. S. Department of Labor

RESULTS of an extensive investigation into infant mortality and its causes in Baltimore, Maryland, have just been made public by the U. S. Department of Labor through the Children's Bureau.

This study is the latest and in many respects the most important of the infant mortality studies made by the bureau (previous investigations having been made in Johnstown, Pa., Manchester, N. H., Waterbury, Conn., Brockton, Mass., Saginaw, Mich., New Bedford, Mass., Akron, Ohio, Pittsburgh, Pa., and Gary, Ind.).

The Baltimore study is especially important because Baltimore is the largest of the cities studied, and also because it is, in its population, the variety of its industries and the rate of infant mortality prevailing, a typical American city.

Poverty, employment of mothers outside the home, housing below the proper standard, short intervals between births, and the death of mothers at or soon after child-birth were among the conditions causing high death rates among certain groups of babies under one year of age, in Baltimore. Similar conditions were found responsible for high infant mortality rates in other cities.

A summary of the findings of the Baltimore report is as follows:

The mortality in the entire group of 10,797 legitimate

SCIENCE

VOL. LVIII SEPTEMBER 14, 1923 No. 1498

CONTENTS

SCIENCE: A Weekly Journal devoted to the Advancement of Science, edited by J. McKeen Cattell and published every Friday by

THE SCIENCE PRESS

Lancaster, Pa. Garrison, N. Y.

New York City: Grand Central Terminal.

Annual Subscription, $6.00. Single Copies, 15 Cts.

SCIENCE is the official organ of the American Association for the Advancement of Science. Information regarding membership in the association may be secured from the office of the permanent secretary, in the Smithsonian Institution Building, Washington, D. C.

Entered as second-class matter July 18, 1923, at the Post Office at Lancaster, Pa., under the Act of March 3, 1879.

THE BEGINNINGS OF PHYSIOLOGICAL RESEARCH IN AMERICA[1]

THE distinguished society of which this gathering represents a chapter has for its main purpose the exploitation of scientific research.

Every interested person who has survived the sixth decade of life must remember that time when the term "research" was the exclusive shibboleth of a very small fraction of the world community whose individuals were scattered singly or in tiny groups throughout civilized lands, who were unknown by and without influence upon the great public whom they served.

To-day the word is in the mouth of the man on the street, and every newspaper typesetter is familiar with its letters.

This extension of vogue is, of course, due to the common knowledge that it is through research alone that the vast acceleration in the accumulation of bodily comforts, of mechanisms for the control of natural forces, of means for the prevention of human ills has been made possible.

One salutary fruit of the world war has been the popular apprehension that its most infernal agencies on the one hand and its saving graces on the other all were born in the laboratories of science. Man bows to power and gladly contributes to the means for its acquisition.

The very popularity of the theme under discussion is fraught with danger to the fine essence on which its flavor depends. "Research" implies not only a problem but a mind—a certain type of mind. So modern is the content of the term that the English language has failed to develop a graceful name to characterize its votary who is, above all, a truth-seeker.

"Investigator" is clumsy; "researcher" is crude; the French "savant" is inadequate; the German "Forscher" seems more fit. It would be a boon should some student of language fish out from our linguistic melting pot some characterization, brief, smooth and descriptive.

It is a type of mind that is to be defined, not talent or genius, but an impulse to wonder, to inquire and to understand. When the problem is solved its spell is broken; "practical" results have no interest except as demonstrations of the abstract truth and progenitors of new phases of thought. The urge of the in-

[1] Read before the Colorado Chapter of Sigma Xi, June 9, 1923.

vestigator is the development of truth; the direction is subsidiary. With adequate intellectual machinery we may witness a Leonardo da Vinci, a Harvey, a Newton, a Thomas Young, a Helmholtz, a Pasteur or a Dante, a Shakespeare or a Goethe. They all wonder, inquire, construct, create because they understand. The essential spirit of the investigator pervades much of our literature not ostensibly devoted to discovery; it bristles in a fugitive article of A. Graham Bell's and is manifestly revealed in many biographies, as in that of the late Walter H. Page.

The original thinker often, *per se*, like "the lunatic, the lover and the poet is of imagination all compact," but, as in any efficient material engine, his motive power is steadied by a regulating device which, in his case, is provided by scientific training.

The subject-matter of research may be divided, after the manner of a moral code, according to the *intention* on which the endeavor is based, into abstract or pure science, on the one hand, and applied or industrial science, including invention, on the other. Scholarship and learning, however necessary to a productive technique, have no specific relation to research. Mere erudition is not fecund unless it finds a resonant receptive apparatus in the human brain.

My contention is that the characteristic of the original investigator is his mental predisposition, probably essentially a hereditary quality, obvious in every infant, which tends to submergence in later life, but which may be fostered and intensified by culture.

There has been a great change in mental or perhaps I should say ethical attitude among educationalists since the late seventies, the period treated of in these remarks. It was then a real war between the classics and science as to their relative fitness for culture of the human intellect. Intrenched in tradition the so-called "humanists" used all their polished weapons and tactics to repulse the onslaught of the uncultured hordes that threatened their stronghold. And then it was found that the very life and savor of the classics itself depended on the application to it of the same point of view and method with which the scientist consistently and consciously developed his armamentarium.

Sir. T. Clifford Allbutt,[2] in his recent characteristic essays notes, "the humanists never very friendly to science. . . . Disliking the raw anatomy of knowledge, with what they called 'The Classics' they built a walled pleasaunce for themselves and dwelt therein, raising florist's blooms and cut flowers, till Wolfe and Schliemann began to throw stones over the fence." Perhaps more than to any other person the entering wedge of science into the respectable educational curriculum was due to the blows of that doughty warrior, Thomas H. Huxley, who was, indeed, known among his intimates as the "General." And no fitter personality could have been found to lead the actual assault against the university stronghold than his intimate coadjutor, Michael Foster. Even so, Foster's increasingly popular course of physiology at Cambridge was long generally stigmatized as "stinks."

Then, in our own country the bomb was thrown by Charles Francis Adams, if I remember correctly, into the placid ranks of our own most conservative university in the form of an essay on "The modern fetich," the fetich being the assumed aggrandizement of culture through the classics.

In those early days a line was sharply drawn between pure and applied science. For the latter was mixed with "business," which all tradition taught was of a mercenary genus. The scientific man who let himself be lured as principal or accessory into the gainful pursuit of knowledge at once hopelessly lost caste. This was before the sunrise of industrial research in science, though already slight glimmerings of the dawn lighted the sky. It has been indeed a remarkable, if inevitable and rational, revolution which to-day has added to the battalions of industry so large a contingent of the best equipped investigators as to make of industrial science a most important agency for the generation of knowledge.

The same general change that has marked the progress of science has been reflected to a degree in features of medical ethics. The profound aversion to forms of belief, as in homeopathy, has given way to tolerance and regulation by broad rules of conduct. But ever new systems of therapeutics are projecting themselves upon us and only time and patience and the spirit of science will suffice to gradually smelt the noble metal from the base—for all beliefs are mixtures. It is interesting to observe the modification of ethical judgments which has already been manifested through a broader perception of the supremacy of the claims of human welfare as exampled, for instance, in the approved patenting of remedial agencies which would be likely to accomplish harm through unregulated exploitation.

Immemorially the medical curriculum has combined these complementary if not antipathetic relations of scientific instruction, the field of thought and the field of practice, however vastly predominant in area the latter. It would be ruinous to progress and efficiency to displace either. Though we sing the attributes of research in pure science, it is the application in practice that really and immediately counts. The two activities are fairly portrayed in the parts played in a reflex action by the afferent impulse and the central mechanism, on the one hand, and the motor impulse

[2] Sir T. Clifford Allbutt, "Greek Medicine in Rome," 1921, p. 5.

and its end organ, on the other; each alone is futile, but together they accomplish a purpose.

In these latter days there has developed what seems to be a final ideal for the union of the antithetic relations of science and practice.

It is witnessed in the, as yet groping, institution of schools of preventive medicine, where the highest flights of the trained imagination of the investigator may find full scope with the single proviso that they be so reined as to effect a single purpose—the welfare of living creatures.

Within the past half century we have seen realized the ideal of a purpose so directed in the life of Pasteur. Thus does moral philosophy come to its own; the stone rejected of the builders has become the chief of the corner. The world events of the past decade form a pedestal, grave-deep, on which to carve this slogan of science.

It seems as though the evolution of education were perceptibly drawing closer to the refrain of the book of Ecclesiastes, where wisdom is pointed as the goal of the seeker; but the doctrine there is urged for a reward, the boon of self-aggrandizement. We may aspire to higher claims and seek to realize the injunction of Christ, to work for the good of others.

The dangers of accomplishment are very real. Few characters can withstand the unwonted temptations which swarm in sudden riches. Our accelerating affluence of discovery in science pure and applied, the insidious examples of luxury in the life of the unworthy threaten the character of the scientific cult. The horseless vehicle outclasses legs and we must look to it that our finest possessions, physical and ethical, do not shrivel in atrophy from disuse. It is the youth and infant of to-day who must be trained to catch the torch from the failing hand of age in the great relay race of scientific progress. The observer with a retrospect of 40 years who compares the ideals of then and now must feel a vague uneasiness that the spirit and language of pure science are fast becoming obsolescent for the newer generations. The guineapiece damned by John Hunter seems to have come to its own.

It is not going too far afield to here applaud the isolated effort which, albeit a feeble one, the medical profession, the greatest school of practical ethics known to-day, here and there is making to withstand the surges of commercialism.

The "whole time" chairs of practical medicine in university medical departments testify to the perception of our imminent danger and the intention to combat it. Modified in detail as the plan must be with knowledge gained from experience, it gives confidence that our real leaders are prepared to grapple with the dangers that confront us.

Preventive medicine even more than the remedial practice of the art bears the stamp of wisdom; and as a spiritual exhibit of altruism it is unsoiled with the stain, "which will not out," of calculated money rewards in actual practice.

But I came here to talk about the beginnings of physiological research in America, for it had been my good fortune to be a personal witness of what might be called the birth of organized research in physiology in this country, and to have been on intimate terms with its accouchers.

There seemed reason to believe that a personal description of some of those who deserve to live in the history of science might not be without value and entertainment.

A judicial estimate of the importance of men and events is admittedly impossible until long after they are passed and gone.

This is largely because our own immediate interests are sensibly involved in recent history; but the final verdict more nearly approaches truth the greater the number of accurate, eye-witnessed facts it has to build on.

I venture to assert that the foundation of what I have called organized physiological research in America was laid by Henry Newell Martin in the biological laboratory of Johns Hopkins University in the fall of 1876.

Do not misunderstand me to say that no physiological research had preceded this era.

None will fail to recall the undying names of Beaumont, that very personification of the genius of solitary research, of Brown-Séquard, of Weir Mitchell, of H. P. Bowditch, of H. C. Wood and many others. But these were widely isolated individuals who, separated from their generation, obeyed the call within them. High as have been the achievements of isolated great men working alone, especially in the history of English physiology, their momentum was bound to fail when not sustained by the contemporary appreciation and critical judgment of a large body of scientific men.

In the late seventies there was no such thing as physiology, in the modern sense, in America. There were not half a dozen working physiologists, no well-equipped laboratories, no students and no demand for scientific foundation in medicine either on the part of the medical profession or the public.

The only physiology was that of the text-books of which those of J. C. Dalton and of the younger Austin Flint, both of New York, were the foremost.

When a medical graduate managed to get a place on the teaching staff of a medical school, almost invariably "proprietary," it was physiology which he was assigned to expound. In the United States pathology had not been born and clinical microscopy had not begun gestation.

The ambitious and thinking student could find among us no answer to his questions nor opportunity for any but clinical training. He who could not afford to go to Germany or France was compelled to remain in ignorance. When one such, who is now a distinguished pathologist, returned to Baltimore, about 1881, after two years of what to him was an intellectual orgy in pathological institutes of Vienna, he made the mistake of presuming that his unique acquirements might be the source of a living wage as a consulting specialist on pathology in his home city. The hope proved futile, for the medical profession had not the education necessary to formulate questions on conditions it did not recognize as problems.

Though in Philadelphia, in 1876, the indomitable energy of men like H. C. Wood and Weir Mitchell, to be followed in a half decade by a galaxy of pupils, not duplicated in later years, was producing original investigation of greater or less value, there was no laboratory with the specific object of inculcating and hatching original thought in physiology. H. P. Bowditch, of Harvard, by reason of his training under Ludwig and his intrinsically high endowments, was the worthy dean of experimental physiological science in America. In contrast, I may recall that for the past decade or more every year there have come to us from a score or more of laboratories a host of original contributions in every field of biological research.

Indeed, to-day every respectable medical school has its laboratories of physiology and pathology and these, with few exceptions, are the loci of original research. To-day every branch of medicine and surgery is represented by a select coterie of active workers known as this or that society or association, who make their investigations wherever material offers, in the clinic, the laboratory or by the bedside. The distinctively laboratory branches of medical science are chiefly represented in the "Federation of American Societies for Experimental Biology" founded in 1913. This association was made by the aggregation of already existent societies, namely: The American Physiological Society, founded December, 1887; the American Society of Biological Chemists, 1906; the American Society for Pharmacology and Experimental Therapeutics, 1908; the American Society of Experimental Pathology, 1913. The total list of membership in 1922 comprised 539 names, all of them those of producing workers for the advance of biology, especially as related to medicine. A most active and productive institution of the same ideals is the Society for Experimental Biology and Medicine, founded by Meltzer in 1903. Its 19 charter members have multiplied to a roster of 549 in 1923. Other similar organizations of national scope, such as the Society for Clinical Investigation, Society for Cancer Research, etc., deserve passing mention. The developments on the morphological side of biology have been equally noteworthy.

Nothing is more indicative of the volume and educational demands of the reading population than the number and character of the scientific journals which it supports. In the first small volume of the "Index Medicus," representing the literature for 1877, there are mentioned all told 64 medical journals, mostly of very mediocre quality, as published in the United States and Canada. Of these not one was devoted to scientific research. In the index of the *Journal* of the American Medical Association for 1921 out of 110 titles of journals from the same area no less than 22 are devoted wholly to original investigations in the biological sciences directly bearing on medicine, and in the remaining 88 journals dealing with medical specialties a large proportion of the pages is devoted to the publication of high-class original research.

In former days, there was a sharp distinction drawn by even the best medical minds between subjects which were scientific or theoretical and those which were of "practical" value. To-day the leading thinkers and operators in surgery talk familiarly of "surgical physiology," and every physician recognizes that he is likely to understand his sick man in proportion as he apprehends "clinical physiology."

We can maintain, therefore, that the period of the past 47 years has witnessed the birth and vigorous development of American biology, of which the supporting trunk is, and must ever be, physiology.

When in the middle seventies, Johns Hopkins, a citizen of Baltimore, determined to devote his great estate to the upbuilding of higher education and of higher medical education in particular, he chose as advisers a group of reflective and far-seeing men who for the most part had been trained in the self-restraint of a Quaker upbringing.

The soundness of judgment displayed by this body of technically ignorant citizens must remain an enduring monument to their sagacity and high character. They culled from the world advisers who were themselves broad humanitarians and foremost among the producers of scientific progress. Perhaps the chief among these were Huxley in England and John S. Billings in this country.

It was realized that education in this country, beginning in the primary school and ending in college, included a field of activity of two dimensions only. No upward growth could be hoped for except from teachers who could produce knowledge as well as impart it. Europe had already found that the development of sound education of any grade depended on the mitosis of original research carried on in laboratory and study of trained and devoted men. To

Europe our young men had been forced to migrate to get behind the scenes or read between the lines of their text-books.

The founders of the Johns Hopkins University determined to establish a new order of institution, one devoted primarily to original research and the critical study of existing knowledge.

Its main body of students from the outset was culled from college graduates, who felt the call of higher science, literature or mathematics. To-day, throughout the length and breadth of the land, the nodes of education are infiltrated with the spiritual enzymes propagated in the mother culture at Baltimore. What was taught there was, perhaps, not so important as knowledge as the way of looking at knowledge. Within the past month Dr. H. S. Pritchett,[3] president of the Carnegie Institute for the Advancement of Teaching, has publicly deplored the calamity suffered by American education through the alleged fall of Johns Hopkins University from its preeminence by reason of the diversion of its energies to the attraction of undergraduate students.

One of the main departments of the university was that devoted to biology which, as Huxley had defined, might be considered to include all the attributes of living matter, but as a matter of fact was there limited to what is known as zoology, the study of the lower forms of animal life, embryology and to animal physiology.

As head of the department of biology a young man was chosen, Henry Newell Martin, who was a direct product of the influence and teaching of the two most understanding men of biological science in England, T. H. Huxley and Michael Foster. The following characterization is largely directly drawn from a biographical sketch of Martin published twelve years ago.[4]

The study of physiology as implanted at the Johns Hopkins University by Martin in October, 1876, was a graft from English physiology, and it may be of interest to you to hear in the words of one of the foremost teachers of English physiology an account of the modern development of his science.

In England, as in America, physiological science from the time of Harvey and before had attracted the loving labors of great men here and there, but never had there been organized instruction in the experimental method, by which alone new discovery of function is possible, until the period of which I am about to speak.

When Sir Michael Foster stopped in Denver, in September, 1900, on his way home after delivering the Lane Lectures in San Francisco, he consented to talk before the local medical school of his own memories of physiology and physiologists in England.

By great good fortune Dr. W. N. Beggs, then editor of the *Colorado Medical Journal*, arranged for a stenographic report of the colloquial lecture, which may be found in the *Colorado Medical Journal*, 1900, VI, 419.

It seems to me to be one of the most living historical sketches I have ever seen and nothing can better serve my purpose than to quote from Foster's extemporaneous words. He says:

It was in the year 1854 when I began my medical studies, but I had a year before attended a course of lectures on physiology breaking into my ordinary studies in order to do that, and my teacher was a man by the name of William Sharpey, a very great man but a man whose name, perhaps, will not occupy the place as that of a great physiologist which it really deserves. Those of you who have studied the structure of bone will remember his name under the title of "Sharpey's fibres." Indeed, he was one of the first to give an accurate description of the true structure of bone.

He was at that time the only pure physiologist in England. . . . Sharpey may perhaps be known to you also as the editor of a book, which for years and years has been and still is a standard work in anatomy in England, "Quain's Anatomy," which deals not only with topographical anatomy, but also with minute structure, with what we now call histology; and Sharpey was the first man to teach histology in a thoroughly systematic method in England. . . . Now Sharpey was, at the time I am speaking of, the greatest physiologist in England, the only person who devoted his whole time to science; and yet even he taught physiology wholly by lectures. He had no physiological laboratory. He had no physiological apparatus whatever. All he did in the way of practical teaching at that time was to show us under the microscope preparations of various tissues. There was no attempt whatever at any practical teaching in physiology. I remember very well when he was lecturing on blood pressure, and was describing to us the then new results of Ludwig, endeavoring to explain to us the blood pressure curve. All he had to help him was his cylinder hat, which he put upon the lecture table before him and with his finger traced upon the hat the course of the curve. That was the way that physiology was taught by Sharpey in England in the year 1854. And yet Sharpey taught it as nobody else taught it. Nobody else in England then was teaching physiology as Sharpey taught it and, as I tell you, he used his hat, and a very old hat it was, as a kymographion, for blood pressure. I remember very well going to him one day after his lecture, in which he had been speaking of the functions of the liver (by that time he had recognized that I had a special interest in physiology) and he said to me, "Well," he said, "I didn't like to say anything about it in my lecture but Claude Bernard in Paris has just sent me a paper which he read before the Academy of Sciences at Paris, and in that paper he has proved that there is present in the

[3] *Scribner's Mag.*, May, 1923, p. 556.

[4] *Bull.* Johns Hopkins Hosp., 1911, xxii, 327.

liver a substance resembling starch which is easily converted into sugar." I said to him, "Good gracious, that is something quite new, isn't it?" That was Claude Bernard's discovery of glycogen.

In words which it seems a pity to delete, Foster goes on to describe how with the aid of Sharpey there was installed for the first time at University College, London, a subordinate position, a lectureship on practical physiology. Foster received the appointment about '64 or '65. But he says:

What could be done was very little. I had a small room. I had a few microscopes. But I began to carry out the instruction in a more systematic manner than had been done before. For instance, I made the men prepare the tissues for themselves. That was a new thing then in histology, and I also made them do for themselves simple experiments on muscle and nerve and other tissues and on live animals. That, I may say, was the beginning of teaching of practical physiology in England. . . . These lectures on physiology were absolutely voluntary, and only the better students were willing to give up the time needed to get a more thorough grasp of physiology. Well, I appointed a time to see the few who wished to spend some time in this new study of luxury, and there came to me a boy, nothing more than a boy, at least he looked like a boy, who said: "I am very sorry, sir; I should like to take your course if I could, but you see my parents are not very well off, and I get my board and lodging by living with a doctor close by." Doctors in England then, as indeed they do very largely now, dispensed their own medicines. I mean when they saw a patient they sent in afterwards the medicines required. In those days medicines were not as compendious as they now are; the doctor could not take the whole pharmacopaeia about in a little case. He either with his own hand or by the help of an assistant had to do a good deal in the way of preparation of medicines, making infusions, rolling pills and making up mixtures and draughts, doing all the things which went under the general name of dispensing. The lad I am speaking of said to me, "I have, in return for my board, to dispense all the doctor's medicines, and that dispensing takes from 2 to 5 o'clock; now your lectures begin at 4, I can not come for the first hour. You go on to six. May I come in for the second hour? I will work hard and try to make up the lost time." I said, "Certainly, certainly." So he came in regularly late. The other boys rather laughed at his coming in late. He came in regularly at 5 o'clock and he worked with such purpose that, in the examination which I had at the end of the course, I awarded him the prize. Well, his name was Henry Newell Martin, and I was so struck with him that I asked him to assist me in my course and he became my demonstrator.

After we had been at University College for either two or three years, Martin carrying on his studies and at the same time helping me, he came to me one day in great trouble because he could not make up his mind. He had obtained what they call a scholarship at Christ College at Cambridge and he could not make up his mind to accept it and go there. He said he didn't want to leave me. But I was able to tell him what nobody else knew at that time . . . that I was going to Cambridge, too, having been invited to be a lecturer on physiology there. So we both went to Cambridge at the same time, and he became at Cambridge at once my demonstrator, as he had been in London, and after a career of considerable brilliancy of some years at Cambridge there came to him an invitation to Johns Hopkins University at Baltimore. So, if I have done nothing more, at all events I sent Henry Newell Martin to America.

Martin was born July 1, 1848, and he was therefore but 28 years old, and looked still younger, when he took up the duties of the most responsible pedagogic position in the United States. He was of Irish parentage and the eldest of twelve children. His father was a clergyman from the south of Ireland, at first a Congregational minister and later a school teacher. His mother, to whom he was manifestly greatly devoted, was from the north of Ireland. A unique course of laboratory work, designed to give a broad view of living forms and functions, had been introduced by Professor Huxley in 1873. Martin helped to import the course at Cambridge and later assisted Huxley himself and under his directions prepared the famous text-book on "Practical Biology."

Each epoch in the world's history is characterized by specific points of view and conflict of opinion on questions that seem for the moment all important. A perfect history would bring to us the environment in time, place, circumstance and feeling of any age.

As said in a previous sketch of Martin: "No adequate estimate of the specific educational forces at work in the late seventies can fail to take into account the influence on the youth of that period of the intellectual atmosphere emanating from the doctrine of evolution."

Darwin's "Descent of Man" appeared in 1871, and soon a strife was on between a protesting and enraged orthodoxy on the one hand and the often iconoclastic forces of thought-liberty on the other.

Professor Huxley, known affectionately by those near him as the "General," as the commander of a ship is known as "the old man," was the splendid and aggressive leader of the Anglo-Saxon believers in evolution. It is not surprising that the internal tempest bred by thoughts of the supernatural in the mind of every thinking youth should have found its outlet along the channels of reason as suggested by evolution when intolerant of traditions of mysticism.

To be frank, the popular notion that the prevailing spirit of the Johns Hopkins staff in those days, at least as regards the biological department, was "agnostic" was sufficiently correct. To-day the conflict between the book of Genesis and science had long been as a tale that is told until a contemporary and a

neighbor of our own bethought him that faded fame might be polished with the ashes of this dead issue.

In those days the student was thrilled by the new demonstrations of the application of the law of the conservation of energy to the living body and a definition of physiology as the "chemistry and physics of the living body" was made with arrogant good faith.

The old doctrine of "vitalism," by which the masters for centuries had explained the phenomena of life, was thought to have been buried forever. It seemed as if at last the phenomena of life itself were soon to surrender themselves to the art of mathematical treatment. But since those days a panorama of discoveries has again well-nigh reduced us to chaos in belief. Then we knew nothing of hormones, of internal secretions, of vitamines, of the ubiquity of enzyme action in vital phenomena. Colloidal chemistry was a nursling. There was no worthy conception of specific surface energies, of adsorption or of ions. The atom was still the ultimate indivisible unit of matter. But, withal, to-day doubt still withholds a verdict as between the mechanistic and vitalistic conceptions of life.

It was one of the chances which determine the course of human life by which it happened that your speaker, a native of Baltimore, graduated at the age of 21 from a New England college some three months before the inauguration of the Johns Hopkins University. His design of studying medicine, which had been constantly in view from the earliest days of volition, found a peremptory obstruction in the lack of funds necessary to such a course.

But thrilled with the divine curiosity concerning the nature and operation of the forces of life, the main thing was to get a chance to study under a competent teacher. A member of the board of trustees of the university secured for me an appointment to visit Professor Martin, whose sufficient distinction it was to have been an associate of Huxley, that grand Napoleon of biological science, who had already enthralled the youth of two continents.

I called on Professor Martin at his rooms and my spirits were lightened when I saw a very young man—he was then 28 and looked younger—who treated me at once something like a companion. He was scarcely of medium height, of slight but well-developed frame. His head was rather small, the eyes blue and wide-open, nose thin and fine, complexion fair and mustache blond. His dress was always strikingly neat, without being foppish. I can not but fancy that Martin then was homesick and keen to relish the devotion of one not far from his own age. Martin accepted me as his assistant in the biological laboratory at a stipend of $250.00 for the first six months. . . .

Martin's ability as a teacher is attested by the eminence of many pupils; his talent as an investigator is recorded in the literature of physiology; but the personality of the man, his kindly tact, the sincerity, the unassuming modesty, devoid of self-consciousness, the loyalty to truth and the indefinable emanation that reaches from man to man, the memory of these is apt to fall with the heartbeats of his companions. I well remember the first week of preparation for class work. There was as yet no laboratory "Diener," and a hundred tasks of household preparation were to be completed in advance. Martin was kinder than he could have known when he stood beside his assistant washing bottles for reagents; and in this, as in every other field, what would have sorely hurt as a menial service he turned into the routine of technical manipulation. While he never gave way to sentimentality, his invariable kindness where he bestowed confidence withstood every strain of daily intercourse. On one occasion he loaned me overnight the manuscript of an important public address which was to be published. Next morning the roll was missing and apparently lost beyond repair, but the delinquent was the only one ruffled by the accident. To his great joy the papers were found to have been left on the counter of a friendly shopkeeper.

For one of his public lectures before a fashionable, and chiefly feminine, audience plans had been devised for the demonstration on a projection screen of familiar physiological activities, such as muscular contraction, reflex action and the heart beat in the frog. Unfortunately the apparatus was not available for proper rehearsal and when the fateful hour came, the nerves and muscles rebelled at the "lime light." Martin would graphically describe a function and then call for demonstration. Again and again I failed him and things looked desperate when he asked in the gloom of turned down lights, "Sewall, is your heart going?"

Humiliation was relieved by the titter that restored the humor of the fair audience. A lecturer might well feel murderous towards an assistant who so failed him, but if Martin felt that way he gave no sign. . . .

Looking back over the history of those days one must marvel at the felicity with which Martin made and then developed opportunities in the unbroken field before him.

Courses in practical biology and practical physiology formed the routine of laboratory work. But soon there were established accessory classes in demonstration and practice.

A selected number of teachers of Baltimore were offered a course of study on Saturday mornings. Listening first to a brief descriptive lecture by the professor, they then adjourned to the laboratory and were

their own hands and eyes carried on for two or three hours such a nature study as had not been conceived in those days.

It was a duty of your speaker to prepare material for that Saturday's class and the obligation fully occupied the spare time of the preceding week. The physicians of the community were invited to a course of physiological demonstrations and many eagerly availed themselves of the opportunity. Martin's unselfish and impelling nature sought the utmost development of all about him.

Martin soon came to be looked upon as the scientific exponent of the medical profession, and through lectures and practical demonstrations he illuminated the minds and raised the ideals of the more ambitious members of the cult. With infinite tact he made abstruse subjects so plain and practical that his hearers often volunteered as real students and helpers. . . . To my mind the most useful teaching of Martin's career is found in an analysis of the elements of his success. It was clear in his case, as has often been established in others, that his success depended on careful preparation for every effort made. I was very much impressed when, after I had spent two years in special study of gastric digestion and he had appointed me to make my maiden lecture on the subject, he asked me a full month before the time whether I had prepared my lecture yet. The thought sprang to my mind, "It may be that this ultra-preparedness has something to do with Martin's success."

Again, once when we were giving parallel courses to the same class, he in the morning and I in the afternoon, he one day apparently ran out of prepared material and to my horror, being one of the audience, he deliberately appropriated the most harmonious thunder I had laboriously stored for the afternoon. I hastened to privately reproach him on the subject, but he only replied, "It doesn't matter, it will do them more good to hear it a second time." This reminds one of the summing up which a great teacher, Michael Foster, I think, made of his pedagogic experience: "Every year I put less into my lectures and say it over oftener." I can recall but two personal criticisms Martin ever made to me; one was because of a tendency to neglect to expound familiar and obvious details in making a physiological demonstration and the other was for a proneness to procrastinate the preparation for a remote exposition.

Martin found time in 1880 to write an excellent text-book of physiology, "The Human Body," which has become very popular in colleges and in a short time a separate, condensed edition, "The Briefer Course," was prepared for use in secondary schools. Nothing that I have said predicates for Johns Hopkins University or its biological department a position of peculiar preeminence among American institutions of learning. Yet it is now a matter of history that to the university was conceded a unique position as an educational leader almost from the opening of its doors.

With phenomenal wisdom the administrators of the university chose for the heads of its departments men who were not merely good lecturers but were investigators and sources of inspiration in their respective fields. The three departments of natural science established, physics, chemistry and biology, were all under the direction of men still far short of middle age.

In those days the young men gathered there were all votaries of what Huxley called "the divine dipsomania of original research."

Of inexpressible value to us, often ill-formed but devoted students, were the precepts and examples of leaders trained in the way of making knowledge. Martin's achievements inculcated the encouraging lesson that the prime requisite of a successful investigator is not "genius" or even great talent, but above all, a faithful, unerring, insatiable desire for truth as a point of view to which must be added a working energy of indomitable persistence and guided by a faith that nothing happens without a reason.

Martin was not a voluminous writer. In his seventeen years of service in Baltimore there were produced by him but fifteen papers covering the results of original researches. . . . I very well remember one morning, I think it was in the fall of 1880, Martin said to me, in effect, "I could not sleep last night and the thought came to me that the problem of isolating the mammalian heart might be solved by getting a return circulation through the coronary vessels." The idea seemed reasonable, and at the close of the day's work we anesthetized a dog, prepared him for artificial respiration and then Professor Martin opened the chest and ligatured one by one the venae cavae and aorta in such a way as to leave sufficient amount of blood in the heart itself. The heart continued to beat in a normal manner, the circuit made by the blood being from the right side, through the lungs to the left side and back again through the coronary vessels in the heart wall to the right ventricle. Thus heart and lungs were completely isolated from the rest of the body and could be studied unaffected by the interference of factors foreign to itself. . . . Isolation of the mammalian heart by the "method of Langendorff" is now a common procedure. Probably few are aware of the real discoverer of the idea. It is interesting to note the character of the problems with which Martin busied himself, and his persistent search for an *experimentum crucis*.

Assisted by Sedgwick he apparently settled experimentally the disputed function of the internal intercostal muscles. They also succeeded in putting a

cannula in a coronary artery of the living dog's heart and directly measuring the blood pressure and pulse wave in the coronary system, though the great Cohnheim had laid down the dictum that occlusion of a main coronary artery was immediately fatal to the physiological action of the heart.

In Martin's time the leaders of thought in physiology felt themselves confronted with a calamity which endangered the autonomy of their science. Physiology in this country did not exist as a profession. Its reason for existence in the mind of even the educated public rested on its relation to medical instruction and it held somewhat the same position in the technical curriculum as grammar does in the academic course. Martin, following the lead of his scientific forebears, insisted that physiology should be regarded as the benefactor not the handmaid of medicine and that it should be cultivated as a pure science absolutely independent of any so-called practical affiliation.

Martin glimpsed the future as by inspiration.

The vast development of our conceptions of vital reactions as manifested in the doctrines of immunity, has occurred wholly since his day. As he foresaw, the temptation to achieve discovery directly applicable to the cure of disease has attracted an overwhelming majority of those whose tastes and talents might have been devoted to a sounder development of the principles of science. The student and the prospector for precious metals both tend to rush to the new field of rumored richness.

The history of science is thickly studded with examples of facts and laws unearthed in the pursuit of pure knowledge which have turned out to be indispensable foundations of daily thought and action. Never could they have been discovered by one bent upon so-called "practical" or patentable information. Both theory and experience combine to uphold the doctrine that *knowledge,* irrespective of human uses, must ever be the foundation of both intellectual and material development.

To come, now, down to a focal conclusion and to try and distil in a sentence what would need a volume to elaborate, what should be our attitude towards offering facilities for research and for training in clinical practice, respectively, in medical education?

It has been postulated here that the original investigator is characterized by a specific trend of mind which makes him ever an amateur insatiate for new things, a type on which the advance of knowledge is almost wholly dependent. But such a type is no more fitted, *per se,* to carry on the details of medical practice or apply the fruits of discovery in the infinite vicissitudes of clinical experience than would the explorer or the pioneer settler of a new country be qualified by nature or training to conduct the civic affairs of a highly organized community.

To help humanity is the goal of mass education.

Science is worthless for the people until in applied art it is coordinated to approximate mechanical exactness.

The clinician must hope to acquire through long years of extramural education a method of thought and action not taught in the medical curriculum. A method to which, indeed, the requirements and attributes of experimental science are largely antagonistic; a peculiar point of view and a communistic method of dealing with human minds and conditions. It would be an egregious tactical blunder to attempt to train all students as investigators; but without injury to any, all may be given the opportunity of an environment to which may react a small percentage of minds attuned by nature to respond to the call of truth Promethean.

HENRY SEWALL

DENVER, COLORADO

RESEARCH COMMITTEES[1]

THE GROWING COMPLEXITY OF ORGANIZATION FOR RESEARCH

RESEARCH enjoys a vogue at present, fortunately and rightly. It is believed in almost as a religion, with much lip service. Lips are likely to be tightly closed when the collection plate is passed.

The organization of research and research committees proceeds apace, to the extent that the unit of ultimate value in fundamental research, that is, the individual research worker is encompassed about with so great a cloud of witnesses.

The American Society of Civil Engineers, the American Concrete Institute, the Western Society of Engineers have research committees and also certain governmental departments. There is the National Research Council, the Engineering Foundation, the research organization of the Association of Land Grant Colleges, which is one of the most powerful of the agencies.

Now, one aspect of science is the simplification and economy of thought, and one aspect of engineering is economy of action. It would be profitable to inquire into the function of any proposed committee before adding to the structure of such committees, in which duplication of effort is less defensible than in the activities of research workers themselves.

For indeed parallel attacks on any research problems are desirable. It is only necessary that researchers should have a knowledge of mutual progress, and

[1] Discussion read before American Society for Testing Materials, June, 1923.

a clearly defined objective placed in its setting in the particular field. It is well, for instance, that the highway department of Illinois, the University of Maryland and Purdue University should have attacked the problem of fatigue of concrete independently.

On Research in General

In academic circles special attainments in two different fields are signalized by two honors—the Phi Beta Kappa and the Sigma Xi, the former in the field of humanities and the latter in scientific research wherein the truth is sought through the study of nature. I do not know how to draw a line between the fields of so-called academic research and so-called industrial or engineering research. Each must advance, if at all, by scientific methods. Considered as a class set apart by their tastes and their aptitudes from the class of producers and constructors, research workers are of a family.

In a recent conversation with a friend whose mental acumen I admire greatly, but whose narrow definition of research I deplore, it seemed to me that there might be a need to attempt to describe some of the characteristics of research. I would suppose that the quality of a research worker is a spiritual quality and is not to be measured by specific actions. Therefore, there is a danger in attempting to formulate a measure. Certainly, there is a clear distinction between the research type of man and the other who has an instinct for controlling others or for production.

My lot has been cast in with those who experiment or perform research in groups; with a program fixed in advance, and an organization to carry it out. Some of the individuals of the group are only required to be painstaking and faithful observers, to be devoted to their task of measurement with precise instruments, whether in the heat of summer's sun or the freezing weather of winter, in confined situations and fatiguing postures. Others have envisaged the problem, organized and secured support for its solution; they may have prepared a working plan, or left that to others.

Some time ago I gathered together from various sources, chiefly from a report of committee of Sigma Xi, a list of the features of research, as follows:

(1) Research work may be in *industrial* fields with a definite aim or in *abstract* science without thought of particular use.
(2) The research may lie in the field of any branch of knowledge that is treated in a scientific spirit, including, of course, the natural sciences, but not excluding mathematics, history, economics and medicine.
(3) The *method* may be by *deduction,* based upon natural phenomena, and always referenced thereto, or by *induction,* using the methods of modern experimental science, both to discover new facts or uncover underlying laws, or the determination of the mechanism by which one event follows another, resulting in a substantial addition to the existing body of knowledge.
(4) The *qualities* by which true research are known are: earnestness, devotion, diligence and system, and in highest form, original and creative work.
(5) Recognition should be given to skill and initiative in devising suitable methods and apparatus for use in observations, and care and devotion shown in difficult observations, skill in arranging and interpreting data, or forming generalizations upon them.
(6) The *result* should be the discovery of something hitherto unknown.

The following are activities and workers not considered:

(1) The work of the mere routine worker without initiative or responsibility.
(2) The manual operations of the mechanic.
(3) The work of the merely critical and negative mind.
(5) Purely regulatory functions.
(6) Those with only the acquisitions of the learned scholar who may have absorbed the results of research.
(7) Inventors, unless they are scientists.

Anatole France has well expressed one fundamental quality of the research worker, namely "curiosity," in the following quotation:

> Et je songeai que la grande vertu de l'homme est peut-être la curiosité. Nous voulons savoir; il est vrai que nous ne saurons jamais rien, mais nous aurons du moins opposé au mystère universel qui nous enveloppe une pensée obstinée et des regards audacieux; toutes les raisons des raisonneurs ne nous queriront point, par bonheur, de cette grande inquiétude qui nous agite devant l'inconnu.

Function of Research Committees

In the first place such a committee must deal gently with the individual researcher. He is often temperamental; he instinctively resents a control which will limit his freedom to follow new paths that open up in the progress of his work; he is apprehensive that he will be betrayed into premature publication by those who are charged with the duty of securing funds to keep the research alive; he guards the product of his research against appropriation by others for unfair credit. Initiative, originality and play of the imagination of the individual investigator must be given free rein.

The personality of the individual researcher should also be guarded in respect to his individual style and

expression in reports, and should not be destyled by editors who reduce everything to dull monotony of official forms. The conclusions of a man who has lived through an investigation should not be whittled down by timorous officials.

And yet here arises a practical difficulty, *viz.*, the proper balance between necessary control by an organization and the individual initiative of the research worker, in the case of large projects such as those underlying the art of highway construction where are involved large expenditures; an organization of researchers comprising various degrees of experience, from routine observers and recorders up to those who conceive and plan the researches and who are responsible for the scientific conclusions and the success attending the expenditures of such large funds. There are also individuals whose services are necessary for the orderly progress of the work, considered as a production job.

Projects are begun only after a statement of definite purpose, a working plan and an appropriation of funds, followed up by an accounting system, not only for expenditures, but from the standpoint of production. The problem here is to provide an effective organization without dampening the initiative of the individual, killing his imagination and destroying that sense of criticism and responsibility which are necessary if large projects in an unknown field are to arrive at useful and significant conclusions.

Where, then, does a research committee find its field of usefulness when not supplied with funds for operating a specific project? It seems to me that such a research committee functions as a staff organization. I have endeavored to define these functions for the research committees of the advisory board on highway research as follows:

(1) The entire purpose of a research committee is to render service to investigators, and to accelerate progress in the attack upon important problems. It avoids any attitude of proprietorship in the researches which form the subject matter of its deliberations, or of any control or direction of the individual researcher, whose initiative and freedom are necessary conditions of his work. Coordination of research is attempted, inspiration given to those who are at work, and the broad interests of research advanced by reasonable publicity concerning activities. Information of work under way is spread abroad so that seekers after knowledge may know where to find it; communications established between fields of research.

(2) Research committees do not formulate standards of methods of test, or approved practices in construction.

(3) Reports of these research committees are not channels for publication of investigations, although a summary of established conclusions from published investigations should appear in the reports to show the status of research.

(4) The unique work of the research committees is:

(a) To bring together researchers who are working in the same field in order to reach a definition of objectives, and to bring to each researcher a knowledge of the technique and progress of his fellow workers.

(b) To assemble, analyze and review the published data of investigations, or the data placed at the disposal of the committees for the purpose of judging the extent and stability of the research basis for standards, or for the principles and laws underlying the field of the work of these committees.

(c) To study needed and profitable research activities.

(d) To stimulate competent agencies to perform research in such fields.

(e) To prepare working plans for specific researches in cooperation with investigators or for submission to research agencies.

(f) To call attention to researches which need financial support, and to recommend a means for securing such support.

(g) To publish information of researches under way, and of the tools of research, as instanced in Bulletin No. 21, entitled "A Census of Highway Research Projects in the United States" published by the National Research Council, and Bulletin No. 35, describing apparatus used in highway research.

Of these services the three outstanding are:

(1) The coordination of the researchers in connecting fields. For instance, the objective of certain researches by highway engineers must be established only in consideration of the traffic on the road. The automotive engineer and the highway engineer should be brought into conference for a definition of their appropriate fields of work and lay out programs of research.

(2) A committee may render valuable service in surveying the data of research to appraise progress and recommend further work; and also evaluate the application of research work in the industry.

(3) A particular field of usefulness is to bring into close relation the laboratory and the field, because very often laboratory men have very meager knowledge of the service of the material, and the requirements fixed by the laboratory may be quite unreal and not appear in the service value of the construction.

THE RESEARCH COMMITTEE FOR THE A. S. T. M.

If only for internal service in the A. S. T. M., a research committee of this society would seem to be necessary to perform these duties in the field of materials of construction where areas overlap, and there is so much of technique in common. Furthermore, the critical scrutiny by competent persons, of the fundamental data of research underlying the work of any

committee would serve to postpone premature standardization and would indicate necessary additional experimentation. I venture also to suggest that the work of such a research committee would prevent, or at least diminish, the tendency observed on the part of officials of the State Highway Commissions to go their own way in the establishment of specifications for materials that must meet the local needs and conditions of the widely varying regions of the United States.

Practical Considerations

It is not sufficient for such committees to set themselves at a table at scattered intervals without a large amount of preparatory work. A research committee needs analysts to prepare the data of research for scrutiny, not only published researches, but those which are complete or nearly so and have not reached channels of publication. The committee is not averaging opinions but rendering judgment upon complete evidence. It is only an illusion to suppose that a research committee can be useful without adequate financial support. Its value is expressed in terms of activity and not in an imposing roster of distinguished names.

Research and Standardization

The necessity of research before standardization has been well expressed by Mr. A. A. Stevenson, chairman of the American Engineering Standards Committee. To take an example: The standardization of colors for signals for highway traffic demands agreements as to conventions by a standardization committee. But underlying this agreement must be research upon the optical and psychological elements of the situation, to be cared for by a research committee. Otherwise the agreements may violate fundamental human reactions.

W. K. Hatt
Advisory Board on Highway Research,
Washington, D. C.

SCIENTIFIC EVENTS

GEORGE LEFEVRE AND THE MARINE BIOLOGICAL LABORATORY[1]

George Lefevre first came to Woods Hole as a Johns Hopkins University student in 1892, having a table in the Fish Commission laboratory, and he was there four summers. In 1897 he became directly connected with the Marine Biological Laboratory as an instructor in the zoology course. He served in this position for two years. Since 1905 he was continuously upon the staff for direction of zoological research; he was fourteen years a trustee and was secretary of the board for ten years. Few of the present or former members of the Woods Hole group have served the laboratory for a longer period. Five of Dr. Lefevre's publications are based wholly or in part upon investigations conducted here. Nearly every summer some of his pupils at the University of Missouri or some of the members of their zoological staff were at our laboratory, and six years the University of Missouri contributed to the financial support of the laboratory, all doubtless through Dr. Lefevre's influence.

But this bare statement of formal connections with the institution gives no adequate idea of the faithfulness of the service rendered, or of the influence of his fine personality and of his accurate work as an investigator. He was an outstanding figure in our Woods Hole group, his unfailing considerateness and courtesy, both as scientist and as friend, together with his genial sense of humor, contributing a large share to that wholesome atmosphere which has been one of the chief assets of this laboratory, so free from personal jealousies. George Lefevre was a sound zoologist who did much good technical scientific work; he was a keen critic, discriminating in suggestion; he was an inspiring teacher; he was an administrator of rare tact, good judgment and efficiency and our Woods Hole Laboratory, as well as his own university, had the benefit of his wise counsel. But, while recognizing to the full his strength as a scientist and as a leader and the thoroughness and devotion of his service to this institution, our chief remembrance of him will be as a sensitive gentleman, a tactful counsellor and a warm-hearted friend. The keen sense of our own loss in his death prompts us to try to express to his colleagues at the University of Missouri and especially to the members of his family our deep sympathy.

[1] From the Minutes of the meeting of the Board of Trustees and of the Corporation of the Marine Biological Laboratory held at Woods Hole, Mass., on August 14, 1923.

WORLD BIRD PROTECTION

Mr. T. Gilbert Pearson, president of the National Association of Audubon Societies, has demonstrated the possibility of creating a league for protecting the wild birds of the world. Leading scientific and conservation societies in nine countries have now organized and are pledged to active endeavors for the protection of the birds in their countries, and in aiding similar movements elsewhere.

This movement was launched at a conference held in London in June of last year. On invitation of Mr. Pearson delegates from several countries met in the home of the Honorable Reginald McKenna and determined that such action was necessary if much of the valuable bird life is to be saved from despoliation. Among the very active members of this conference

were Lord Edward Grey and Lord Buxton, of England; P. G. Van Tienhoven, of Holland, and the eminent naturalist, M. Jean Delacour, of France.

Mr. Pearson, who has just returned on the U. S. Steamship *Leviathan* from a lecturing and organizing tour through seven of the countries in Europe, writes:

Europe is looking to America for leadership in some of the lines of endeavor in which we as a nation have specialized. There is no country in the world that is so thoroughly organized and has such advanced laws for bird protection as the United States, and many of our methods can be and doubtless will be adapted to meet European conditions.

Through southern Europe especially very little attention is paid to bird protection. This may be illustrated by the fact that in all France in the year 1921 there were only sixty convictions for violation of the bird laws. During the same period in New York State alone there were more than one thousand. In Hungary I was told that during the past year with all of the thousands of bird killers in the country not one had been prosecuted. In Italy I saw nets, traps and various cages used to catch small song birds for food. There is a vast traffic in the bodies of those little songsters in that country. In Rome I saw in cages small birds whose eyes had been blinded by red hot irons on the theory that in their darkness they would sing better and thus prove more effective decoys in alluring other feathered friends to destruction.

Our International organization is now in effective operation in the United States, Canada, Australia, Norway, England, Holland, Luxemburg, France and Italy. Other countries have recently been invited to unite with the movement, and action by them may be expected soon. Members of the committee in the different countries are formed into national sections which deal especially with bird protective problems distinctly national in their scope.

Everywhere I went in Europe our plan was received most cordially.

INDUSTRIAL STANDARDIZATION

WE learn from *The Electrical World* that an unofficial conference of the secretaries of various standardizing organizations was held early in July at Zurich, Switzerland. This was the second conference of its kind held, the first conference having taken place in London in April, 1921. At that conference the secretaries of seven standardizing organizations were present, whereas at the Zurich conference secretaries from thirteen different countries were present. These included representatives from Austria, Belgium, Canada, Czechoslovakia, France, Germany, Great Britain, Holland, Italy, Norway, Sweden, Switzerland and the United States.

The conference, which lasted from July 3 to July 6, was given over to a discussion of the practical application of standards in the various countries and of the extent to which international collaboration is possible. There is a marked difference in industrial standardization and in the method of its application in the various countries involved. In Great Britain and in the United States the standardizing body is an industrial organization seeking government support, while in France, for example, the standardizing body is a government institution.

Reports were made by the various secretaries on progress in the different countries, and the American representative, Dr. Paul G. Agnew, was supported in his resolution that in order to help the cause of standardization ideas can not be exchanged too soon. Possessing no executive authority, the recommendations made by the secretaries as a whole will have to be placed before the executives of the respective national organizations. Progress has been made, however, toward closer international collaboration between secretaries and toward international amity on questions of standards. Mr. Zollinger, secretary of the Swiss committee, acted as chairman of the conference, and C. le Maistre of Great Britain acted as vice-chairman.

THE AMERICAN PUBLIC HEALTH ASSOCIATION

THE American Public Health Association extends to the public health profession and others interested a cordial invitation to attend its fifty-second annual meeting, in Boston, from October 8 to 11. Headquarters will be at the Copley-Plaza Hotel.

The annual meetings are always important events and the meeting this year is of more than usual interest since it ends the first twelve months of the new program adopted as a result of the association's reorganization in 1922. Two general sessions and twenty-six meetings of the scientific sessions will be held this year. In addition, many trips of technical and general interest have been planned in historic Boston as part of the entertainment and educational program. On Monday evening, October 8, the formal opening session will be followed by a reception. On Wednesday evening, October 10, Sir Thomas Oliver, the distinguished English industrial hygienist, and Dr. George E. Vincent, president of the Rockefeller Foundation, will address the second general session. The scientific program, embracing all branches of public health, will be held according to sections as follows: Public Health Administration, Laboratory, Sanitary Engineering, Vital Statistics, Child Hygiene, Food and Drugs, Industrial Hygiene, Public Health Nursing, Health Education and Publicity.

Among the subjects scheduled for discussion are papers on food inspection, growth of children, full-time health officers, mental hygiene in the school program, nutrition work, the effect of so-called moonshine liquors, standards for school house construction and

sanitation, epidemiology, better birth registration, organic heart disease, studies on the etiology of common colds, water supply and purification, mosquito control, etc.

A report of the committee on municipal health department practice will be presented before the section for Public Health Administration. At this time the announced plan for the awards to cities for distinctive community service will be discussed. The problems of health officers in small communities will be specially considered at a round-table discussion scheduled for Wednesday morning. The clinic on printed matter, which has proved valuable in past years, will be held again this year by the Section on Health Education and Publicity. At this clinic, samples of public health publicity will be examined and criticized by experts. Of special interest also is the report of the committee on health problems in education of the Section of Child Hygiene.

The September issue of *The American Journal of Public Health* carries the preliminary annual meeting program arranged by sections, and the October journal will contain additional information. Members of the association, traveling by rail to Boston, may secure a reduction of one fourth the regular round-trip rate.

THE LAKE STATES FOREST EXPERIMENT STATION

The new Lake States Forest Experiment Station, as was reported here last week, is to be established at St. Paul, Minnesota, in cooperation with the Minnesota Agricultural College. The selection of a site for the new project in forestry research recently authorized by the Congress has been under consideration for some time. Owing to the presence of the Forest Products Laboratory and the ease with which cooperation might be effected between the new station and the older branch of the Forest Service, Madison, Wisconsin, was given serious thought as a site. It was decided, however, that the greatest good would result from the St. Paul location. The first problem to be undertaken by the experiment station will be the reforestation of the Upper Peninsula and the northern part of the Lower Peninsula of Michigan.

Although the experiment station is not to be located in Madison, its staff plans to cooperate fully with the authorities of the University of Wisconsin, the Conservation Commission of Wisconsin and with the Forest Products Laboratory.

It is the plan of the department of agriculture to have the Forest Experiment station do for forestry what agricultural experiment stations do for farming. To grow timber crops on idle lands unfit for agriculture and to perpetuate the hardwood lumber supply upon which the great furniture and woodworking industries of Michigan, Minnesota and Wisconsin depend, are the primary objects of the Lake States Station.

Dr. Raphael Zon, of the Forest Service, is to be the director of the new station. Dr. Zon, who enjoys an international reputation as a forester, has been identified with experiment stations for the past twenty-two years. He happens, moreover, to have a particularly wide knowledge of forestry in the Great Lake states.

Other members of the headquarters staff of the new station include Joseph Kittredge, Jr., who is now the chief of the office of forest investigations in the Forest Service, and A. J. Mitchell, a graduate of the Michigan Agricultural College, who has worked for many years in the Lake States in connection with fire protection organization. H. Grossman, a graduate of the University of Michigan, who has had considerable experience on the National Forests in the Northwest, and A. F. Wackerman, a graduate of the University of Minnesota, complete the staff as at present formed, thus giving the new station the services of men who are well acquainted with forest conditions in the Lake States.

One of the main purposes of the new Forest Experiment Station, which will be regional in character and which will devote its efforts to the problems of the Lake States as a whole, will be the correlation of the forest research and related interests and activities so that the maximum results may be accomplished without wasteful duplication.

As one of the means to bring about such a correlation, the Forest Service plans to organize a research council in the Lake States. This council will consist of representatives of the state department of forestry, forest schools, agricultural colleges, as well as representatives of the lumber, pulp and paper, furniture and wood-using industries in the Lake States region.

It is planned to have the council act in an advisory capacity for the Lake States Experiment station in suggesting problems that stand in need of solution, and in suggesting localities where studies should be made. It will also act as a clearing house for all forest investigations that may be conducted in the region, so that if a particular problem is already being studied at a forest school or by some state forest department, no attempt will be made to duplicate that study. On the contrary, such studies by the existing agencies will be encouraged, and the time and resources of the Federal experiment station devoted to other problems.

FELLOWSHIPS IN MEDICINE OF THE NATIONAL RESEARCH COUNCIL

During the first year of the operation of these fellowships thirty-one (31) individuals were appointed for work in the various fields of medicine and in dif-

ferent universities and institutions. A considerable number of these fellows requested reappointment for continuation of their work at the same place or elsewhere and of these fourteen were reappointed, as listed herewith:

Name	*Place of Work*	*Specialty*
Albritton, Erritt C.	Ohio State University	Physiology
Andrus, William D.	University of Cincinnati	Surgery
Anson, Barry J.	Harvard Medical School	Anatomy
Bent, Michael J.	College of Physicians and Surgeons, New York City	Bacteriology
Cone, William V.	Iowa State University	Neuropathology
Curtis, George M.	Rush Medical School	Surgery-Medicine
Davis, Loyal E.	Northwestern University	Neuro-surgery
Ferry, Ronald M.	Harvard Medical School	Biochemistry
Lennox, William G.	Harvard Medical School	Medicine
MacCready, Paul B.	Johns Hopkins Medical School	Laryngology
McLean, Jay	Leipzig	Surgery
Reznikoff, Paul	Harvard Medical School	Physiology-Medicine
Rosenthal, Sanford M.	Johns Hopkins University	Pharmacology
Shibley, Gerald S.	Columbia University	Medicine

Following a recent decision of the Medical Fellowship Board, for a time at least, no fellows will be appointed directly for work in a clinical branch of medicine unless they have served or plan to serve an apprenticeship in one of the medical sciences. With this purpose in mind, a limited number of new fellows were appointed for the ensuing year, beginning July 1, 1923, or shortly thereafter, as follows:

Name	*Place of Work*	*Specialty*
Andrus, Edwin Cowles	University of London	Physiology
Barker, Howard B.	University of Michigan	Anatomy
Kleitman, Nathaniel	Oxford University, England	Physiology
Morgan, David P.	Harvard Medical School	Biochemistry
Schwartze, Erich W.	University of London	Pharmacology
Scott, Joseph M.	Johns Hopkins School of Hygiene and Public Health	Bacteriology and Parasitology
Smith, Harry P.	Columbia University	Chemistry and Pathology

Other appointments may be made for the ensuing year at the meeting of the board to be held in September from a considerable list of candidates that applied on or before August 1.

Frederick P. Gay
Chairman, Medical Fellowship Board,
National Research Council

SCIENTIFIC NOTES AND NEWS

The ninety-first annual meeting of the British Association for the Advancement of Science opened at Liverpool on September 12 with the presidential address of Sir Ernest Rutherford.

At the Edinburgh meeting of the International Physiological Congress an invitation to meet in America was presented by Professor A. J. Carlson, president of the American Physiological Society, and an international committee was appointed to consider the possibility of accepting it for 1926.

The International Congress of Psychology at Oxford also considered the question of meeting in the United States three years hence.

Professor I. P. Pawlow, of Petrograd, was present at the International Physiological Congress, at which he made one of the three general addresses and was one of the members receiving honorary degrees from the University of Edinburgh. It will be remembered that he was refused a British *visa* on leaving New York. We learn from *Nature* that permission to land at Southampton (instead of Cherbourg) was obtained by wireless telegraphy during the voyage, through the enterprise of an American colleague and fellow-passenger, who communicated with an English physiologist.

The nineteenth South African Medical Congress will be held next year in Grahamstown, Cape Province, under the presidency of Dr. E. G. Dru Drury, of Grahamstown.

A German Society for Dental Anatomy and Pathology has recently been founded under the presidency of Professor Römer, director of the Leipzig University Dental Institute.

Leslie C. Beard, Jr., instructor in chemistry in Johns Hopkins University, has become a chemist for the Standard Oil Company of New York. Raphael Rosen, who received the doctor's degree from Clark University in February, has joined the research staff.

E. B. Brown, who during the past two years has

held the National Tuberculosis Association Fellowship in organic chemistry and biochemistry at Yale University, has resigned to accept a position as research chemist in the Fleischmann Laboratories.

E. J. CASSELMAN, of the Westinghouse Electric and Manufacturing Company, has accepted a fellowship in ceramics at the Mellon Institute.

FRANK B. GORIN has been appointed chief of the heavy chemicals section of the Chemical Division, Bureau of Foreign and Domestic Commerce.

DR. RHODA ERDMANN, formerly connected with Yale University, has been placed in charge of a special department of the Institute for Cancer Research at Berlin for cultivation of tissue cells outside the organism.

THE *Journal* of the American Medical Association reports that the Japanese government's subsidy for the encouragement of medical research for the present year (amounting to about 53,000 yen) has been given to some fifty research workers in fifteen medical colleges, eight special schools of medicine, pharmacology and dentistry, and two institutes. Some of the beneficiaries are: Professor T. Irisawa of the Tokyo Imperial University Medical College for his work on "Influence of Rice-Bran Extract on Beriberi"; Professor J. Simazomo, Kyoto Imperial University Medical College ("Nutritive Value of Japanese Food"), and Professor M. Yamado of the Nagasaki Medical College ("Therapy of Filaria Bancrofti").

A SENIOR Bert Memorial Fellowship of the value of £600 per annum has been awarded to Dr. David Keilin, a fourth year fellow working under Professor G. H. Nuttall, F.R.S., at the Molteno Institute for Research in Parasitology, University of Cambridge, on the life-history of parasitic protista and on the physiology of parasitic metazoa. A fourth year fellowship of the value of £400 per annum has been awarded to Miss Katherine Hope Coward, D.Sc., now working at the biochemical laboratory, Institute of Physiology, University College, University of London, on an investigation into the process of metabolism, nutrition and growth of young animals, particularly with reference to so-called deficiency diseases, such as rickets.

MR. D. C. CARROLL, Trinity Hall, Cambridge, has been elected to the Michael Foster research studentship, and Dr. C. C. Worster-Drought, Downing College, has been elected to the E. G. Fearnsides research scholarship.

THE two prizes offered by the Medical and Surgical Society of Guayaquil for the best reviews of the work of Pasteur were awarded to Dr. F. López of Quito and Dr. Luis Espinosa Tamayo of Guayaquil. A silver tablet with inscription was the first prize. Both articles are to be published in the *Anales* of the society.

DR. HAROLD I. GOSLINE, clinical director and pathologist at the State Hospital for Mental Diseases, Howard, Rhode Island, has been called to the position of chief psychiatrist and clinic director of the Dallas (Texas) Child Guidance Clinic.

DR. HENRY FAIRFIELD OSBORN has sailed for Mongolia from Seattle to join the third Asiatic expedition of the American Museum of Natural History.

IT is reported that Professor W. T. Councilman, of the Harvard Medical School, and Mrs. Councilman, *en route* to Peking, left the Tokio region before the disaster in Japan and are safely on the way to China.

PROFESSOR W. G. CADY, of Wesleyan University, has returned from a half year's leave of absence abroad, in the course of which he made a series of comparisons of radio wave-length standards in Italy, France and England. A set of piezo-electric resonators, which had previously been calibrated at the Bureau of Standards, served as high-frequency wave-length standards, and were compared with wave-meters of other standards in Rome, Livorno, Paris, Teddington and Farnborough.

A STAFF of government experts will sail from Seattle on September 11 for the Philippines to study the possibilities of rubber production in the islands. The survey to be made is in connection with the investigations being conducted by the Department of Commerce to locate areas for American controlled rubber production to combat foreign monopolies of the supply of the raw material. The party to make the investigation in the Philippine Islands consists of C. F. Vance, of Troy, Ohio, special agent of the department, in charge; A. H. Muzzal, of Carpinteria, Calif.; John P. Bushnell, of Washington, D. C., and Marl Baldwin, of the Bureau of Soils of the Agricultural Department.

A RADIO message has been received from Donald B. Macmillan stating that his Arctic Expedition has reached latitude 78° 30″. This indicates that *The Bowdoin* has reached Etah, on the northwest coast of Greenland, 2,300 air miles north of Boston.

NORMAN CLYDE, a teacher of Weaverville, Calif., on August 24 completed for the first time the ascent of Mount Wilbur, 9,293 feet high, in Glacier National Park.

DR. C. U. ARIENS KAPPERS, director of The Netherlands Central Brain Institute, Amsterdam, has

sailed from Marseilles en route to Peking, where he will give lectures in the Union Medical School, during the coming session. In his absence Dr. C. J. van der Horst, assistant director of the institute, will be in charge. During the summer, American workers at the laboratory have been Dr. W. H. Addison, of the University of Pennsylvania, and Dr. H. H. Charlton, of the University of Missouri.

SIR THOMAS OLIVER, the British authority on occupational diseases, arrived in New York on September 1. He will address the St. Louis Medical Society, the National Safety Congress and the American Public Health Association.

DR. F. L. HOFFMAN, chairman of the Committee on Statistics of the American Society for the Control of Cancer, will contribute an address to the forthcoming Belgian National Congress on cancer.

THE eighth summer meeting of the Mathematical Association of America was held at Vassar College, Poughkeepsie, New York, on Wednesday and Thursday, September 5–6, in conjunction with and immediately preceding the summer meeting of the American Mathematical Society which will continue on Friday and Saturday. A joint session of the two organizations was held on Thursday afternoon, and the joint dinner was held on Thursday evening.

THE next meeting of the American Electrochemical Society is to be held in Dayton, Ohio, on September 27, 28 and 29, 1923. The meeting will include a symposium on electrochemistry of gaseous conduction, in charge of Duncan MacRae, Research Laboratory, Westinghouse Lamp Co., Bloomfield, N. J., and a symposium on recent progress in electrolytic refining, under the chairmanship of F. R. Pyne, U. S. Metals Refining Co., Carteret, N. J. An innovation at the meeting will consist of round-table discussions on electric-furnace brass-foundry practice, organic electrochemistry, chlorine and electroplating. There will also be excursions to local plants.

THE 1923 convention of the Illuminating Engineering Society is to be held September 24 to 28, inclusive, at Lake George, N. Y. A well-balanced program of commercial and technical papers is being prepared by the committee under the direction of Mr. J. L. Stair, of Chicago. The officers of the general convention committee are: W. D'A. Ryan, *chairman;* H. W. Peck, *vice-chairman,* and H. E. Mahan, *secretary.*

AN International Congress for Cattle Breeding was held at the Hague from August 29 to September 4. The program included both beef and dairy cattle, with technical problems of heredity and nutrition, and with practical questions such as registration, government assistance, etc. The secretary was H. G. A. Leignes Bakhoven, Leeuwarden, The Netherlands.

AN international congress on dairying, known as the World's Dairy Congress, will be held at Washington, D. C., on October 2 and 3, at Philadelphia, Pa., on October 4 and at Syracuse, N. Y., in connection with the National Dairy Exposition, from October 5 to 10. Thirty-six countries have accepted President Harding's invitation to send delegates. The program, in addition to discussions of economic and business questions, will include some 200 papers on the breeding and nutrition of dairy animals, the chemistry and bacteriology of milk and milk products and on the nutritional value of milk in the diet of children.

AT the sixth annual meeting of the Northwestern Association of Horticulturists, Entomologists and Plant Pathologists, held at Boise, Idaho, from July 23 to 26, over sixty scientific men were present from Oregon, Washington, Idaho, Utah, Montana and British Columbia. The officers elected for the coming year are as follows: *President,* C. W. Hungerford, plant pathologist, University of Idaho. *Vice-President,* E. J. Newcomer, entomologist, U. S. D. A., Yakima, Washington. *Secretary-Treasurer,* W. T. Hunter, district horticulturist, Vernon, British Columbia. The meeting next year will be held in British Columbia.

THE seventeenth French Congress of Medicine was held at Bordeaux from September 27 to 29. The subjects for discussion include: (1) Remote sequelae of malaria, by Professor Le Dantec, Dr. Hesnard, Dr. Marcel Léger and Dr. Broden, of Brussels; (2) relationship of the sympathetic system and the endocrine glands in pathology, by Professor Pachon and Dr. Perrin; (3) treatment of meningococcal infections, by Professor Dopter and Dr. Boidin.

UNIVERSITY AND EDUCATIONAL NOTES

A DECREASE of 644 in the number of students of electrical engineering enrolled in 129 technical schools of the United States for the year 1922–23 as compared with 1921–22 is shown by figures compiled by Walton St. John of the United States Bureau of Education, the respective totals being 13,275 and 13,919. Similar decreases are shown in the registration for other branches of engineering, civil engineering, with an enrolment of 12,802, showing a loss of 1,590; mechanical engineering, with an enrolment of 14,453, a loss of 1,561; chemical engineering, with an enrolment of 7,054, a loss of 1,668, and mining and metallurgical engineering, with an enrolment of 2,895, a loss of 234.

DR. TOWNER R. LEIGH has been appointed director of the new school of pharmacy, for which money was pledged by the Florida State Pharmaceutical Association. It was opened at the University of Florida on September 10 by the state board of control.

DR. CLARENCE M. HYLAND, recently connected with Creighton University College of Medicine, has been appointed professor of pathology in the Bellevue Hospital Medical College, New York.

IN the University of Texas Department of Medicine, Galveston, Dr. H. O. Knight, formerly associate professor, has been promoted to full professor of anatomy; Dr. George E. Bethel, to be adjunct professor of anatomy, and Drs. G. W. N. Eggers, C. R. Enloe and E. M. Jordan instructors in anatomy.

JOHN L. EBAUGH, Jr., for the past two years instructor in chemistry at Tulane University, New Orleans, has been appointed instructor in chemistry at the Drexel Institute, Philadelphia.

DR. GEORGE EDWIN JOHNSON, professor of biology in the University of Porto Rico from 1917 to 1921, has been called to the chair of biology in the University of Mississippi.

DR. J. F. KESSEL, who has been during the past year university fellow in zoology at the University of California, sailed on August 21 for China, to take up his work as instructor in biology in the pre-medical school of Peking Union Medical College.

DISCUSSION AND CORRESPONDENCE

MEDICINE AND RELATED ARTS IN CHEMICAL LABORATORIES

THE attack on the medical profession in your issue of August 3, pages 79 and 80, based upon its supposed plan for insuring efficiency in clinical laboratory service, is unwarranted and destined to do harm. No such plan as that outlined by your correspondent, nor any other plan, has been adopted by the American Medical Association or by any of its scientific sections. Published records of the association (*Journal* A. M. A., July 7, 1923, page 35, and July 14, 1923, page 120), which were available to your correspondent, clearly show the extent to which the association has gone in this matter. Arrangements were authorized by the House of Delegates in June, 1923, at the request of the American Chemical Society, under which the association will cooperate with the American Chemical Society and other technical organizations in mapping out jointly a policy with reference to the control of clinical laboratories. The issue of a defiance and a threat by your correspondent, at this time and in such a way as to give them seemingly the support of the American Chemical Society, is hardly likely to contribute toward that cooperation which the officers of the American Medical Association and of the American Chemical Society have been at considerable pains to establish.

The Section on Pathology and Physiology of the Scientific Assembly of the American Medical Association, at its St. Louis meeting, 1922, upon the proceedings of which your correspondent seems largely to base his attack, did no more than create a committee to determine the practicability of standardizing clinical laboratories (*Journal* A. M. A., June 10, 1922, page 1810). The report of that committee, submitted at the San Francisco meeting in June, 1923, was unanimously adopted by the section and approved by the House of Delegates (*Journal* A. M. A., July 14, 1923, page 121), and stands as the action of the association. It provides merely for an investigation of clinical laboratories with a view to having some adequate supervision over them established. The papers and the discussion at the St. Louis meeting (*Journal* A. M. A., September 9, 1922, pages 861–867), to which your correspondent refers in support of his contentions and from which he quotes, represent in themselves merely the views of individual members of the association, not the views of the association or of the section. Even so, however, your readers will find little in them to support your correspondent's views concerning the attitude of the medical profession toward the activities in clinical laboratories of scientific men trained in fields other than medicine, and much to indicate medical appreciation of the work of such men. It is hoped that your readers will accept the invitation of your correspondent to read the papers and discussion referred to.

The medical profession has no need to be reminded of the extent to which the success of a physician and the safety of his patient depend on sciences and arts other than medicine. The American Medical Association itself long ago established its Council on Pharmacy and Chemistry and maintains at its headquarters a thoroughly equipped chemical laboratory under the direction of highly trained chemists. It is, in fact, the very dependence of medicine on certain related sciences and arts that renders it imperative that something be done to make certain that chemists, physicists, bacteriologists and others undertaking medical and quasi-medical work are fully qualified. It would be unfortunate, indeed, if indiscreet utterances on the part of any one should hinder the movement to that end.

WM. C. WOODWARD,
Executive Secretary

BUREAU OF LEGAL MEDICINE AND LEGISLATION, AMERICAN MEDICAL ASSOCIATION

AN INTERESTING COPEPOD FROM THE FINGER LAKES, NEW YORK

During the summers of 1910 and 1918, limnological studies were made on the Finger Lakes of New York for the United States Bureau of Fisheries. In these investigations a considerable amount of plankton material was collected from the lakes that were visited, but the various forms of crustacea were not carefully identified at that time. A more thorough study of this material recently led to the discovery of an unusually interesting copepod in the catches from the lower water of three of the lakes, namely, Seneca, Cayuga and Owasco. This copepod belongs to the calanoid group, but differs so widely from the other members that it represents a new genus and most probably a new family. A full description and figures of the form are being published elsewhere under the name of *Senecella calanoides*.

The female possesses only four pairs of swimming feet, while the fifth pair in the adult male is unusually large, extending well beyond the furcal rami, and greatly modified. Each antenna of the first pair consists of twenty-five segments in both sexes; the right one is exactly like the left one in the adult male, there being no geniculating modification of the right member. Each of these antennae bears fifteen sensory appendages in the adult male, but only seven in the female. In the adult male the oral appendages are reduced, the maxilla, mandible and first maxilliped being much smaller and weaker than those of the female and the immature male. The reduction is so marked, in fact, that it is difficult to see how the male can secure a sufficient quantity of food and masticate it with these reduced appendages. The significance of this reduction, therefore, is a very puzzling question. The modification of these appendages appears to take place during the last moult. Immature males having a length of 2.35 millimeters have these mouth parts as fully developed as the females, but mature males, which have a length of 2.45 to 2.55 millimeters, possess the reduced oral appendages. The female is somewhat larger than the male, ranging from 2.65 to 2.85 millimeters in length.

On the basis of its structure *Senecella calanoides* is more closely related to some of the marine calanoids than it is to any of the fresh-water members of this group. The closer relationship to marine forms suggests that this copepod may have reached the Finger Lakes during the marine invasion of the St. Lawrence valley following the last glacial period. At that time oceanic waters occupied Lake Ontario, forming a body of water known as Gilbert Gulf.[1] In a personal communication Professor H. L. Fairchild states that marine waters did not enter the Finger Lakes. Lake Iroquois, which occupied the Ontario basin prior to the marine invasion, sent a tongue into the Cayuga basin, but the Gilbert Gulf plane was 290 feet lower than that of Lake Iroquois. The passage of this form from Gilbert Gulf to the Finger Lakes was not accomplished, therefore, by a marine invasion of the latter, but by some other agency.

If this copepod reached the Finger Lakes by way of Gilbert Gulf one might expect it to adapt itself to the freshened state of the water at the end of the marine invasion and thus be an inhabitant of Lake Ontario at the present time; but this does not seem to be the case. Professor W. A. Clemens, of Toronto University, kindly loaned some plankton material which he collected in Lake Ontario on October 3, 1922, but *Senecella* is not represented in these catches which extended to a depth of 372 feet.

Two species of the larger copepods inhabit the cool lower waters of the deeper Finger Lakes, namely, *Senecella calanoides* found in Seneca, Cayuga and Owasco, and *Limnocalanus macrurus* in Canandaigua Lake; in none of the catches, however, were both species obtained from the same lake during the season covered by these collections, or from late July to early September. That is, they seem to be mutually exclusive during this time; it would be interesting to know whether this phenomenon obtains throughout the year and, if so, what factors are responsible for this exclusiveness.

CHANCEY JUDAY
GEOLOGICAL AND NATURAL HISTORY SURVEY, MADISON, WISCONSIN

[1] Studies in Indiana Geography, pp. 90–111. 1907; Bul. No. 209-210, N. Y. State Museum, p. 62, 1920.

THYROID CULTURES OF PARAMECIA

AT various times during the past year the writer has had occasion to make some thyroid cultures of paramecium caudatum. It was noted that these animals found this habitat more favorable to existence and reproduction than the ordinary hay-infusions.

Such a paramecium thyroid culture may be easily made by mixing about two grams of Armour's Desiccated Sheep Thyroids (U. S. P.) with 2,500 c.c. spring water. This mixture should be slightly stirred and allowed to stand exposed to the air for a half hour. Several pipettes-full of fluid containing paramecia are then introduced. If the culture jar is covered with a top and carefully sealed with vaseline an excellent, clear culture will be obtained. After several days it can be noticed that the animals are evenly distributed throughout the liquid, and are not congested about the top of the jar as in ordinary cultures. The cultures usually need but little attention. However, it is sometimes found desirable to add a little fresh water every week or ten days.

WILLIAM L. STRAUS, JR.
THE JOHNS HOPKINS UNIVERSITY

QUOTATIONS

BRITISH DYES

The British Dyestuffs Corporation is something far more than an ordinary commercial enterprise; it is the practical manifestation of a deep-rooted determination of the nation to become independent of foreign sources for commodities as essential to commerce in peace as they are vital to self-preservation in war; the whole country through the Government investment in its capital has a stake in its success. In these circumstances the resignation of Dr. Green on the ground that he differs from the Board in regard to its adopted policy can not be passed over as a matter of private concern. Dr. Green thinks that the scientific side should be represented on the board, and he is not alone in his contention. On the other hand, the chairman announced at the annual meeting last year that in future the administration of the undertaking would be directed by a board of business men, who would retain the services of scientific experts at the head of the technical and research departments. That policy was endorsed by the shareholders and reaffirmed by them last month. Dr. Green, finding himself unable to agree with this view, has thought it right to offer his resignation, and the Board have accepted it. We feel sure that there will be general regret that so eminent a chemist should feel compelled to dissociate himself from the enterprise, but the personal aspects of the matter are of far less importance than the wider question of policy at issue.

During the four years ended last October the corporation and its associated companies spent over £400,000 on research. The sum is large, but the task of overtaking the German makers was extremely heavy. Before a maker is in a position to supply a dye to users on a commercial basis two things are necessary—its composition must be discovered, and its production on an economic basis must be ensured. Experience teaches that results in the laboratory alone are not by any means sufficient; there remains the task of the works staff in discovering how to produce the commodity in bulk of a quality at least equal to that offered by a rival concern and at a cost that enables it to be sold to the consumer at a competitive price. We understand that to-day the British Dyestuffs Corporation has established the constitution of colors available for commercial use, while Mr. Sutcliffe Smith, chairman of the Color Users' Association, declared last June that he had no reason for doubting the statement that British makers were now producing 80 per cent. of the color used in this country. That leaves a margin of 20 per cent. which British makers have not yet succeeded in producing on a commercial, as distinct from a laboratory, basis. To filling in the gap the Corporation is now devoting its energies, for the chairman announced at the annual meeting last month that henceforth the principal aim would be to utilize the research organization for the purpose of securing increased yields of products in actual manufacture and of introducing such new colors as are in steady demand by the consuming trades. In other words, the Board thought that the time had arrived when the effecting of economies in the cost of production and extending the range of dyes in demand by consumers were of greater importance than research prosecuted with a view to new discoveries. Justification for this view is to be found in the financial state of the Corporation's affairs and the urgency of the demand by consumers for reduction in prices. It must be remembered that the Corporation is only able to carry on because it is protected from underselling on the home market by Government restriction of imports. Such protection is absolutely necessary if the dye industry is to be established here; but it is impossible not to sympathize with the users' contention that they are bearing the burden of creating the industry and are placed at a temporary disadvantage through being compelled to pay a higher price than users who are in a position to import freely, and so to obtain the advantage of a depreciated exchange. On this ground alone the corporation is right to insist on rigid economy in all directions in order to cut costs to the lowest possible level.

There remains the question of finance, which is another vital factor in determining the policy of the board. When subscriptions were invited on the formation of the company, the inducement was offered that the government would protect the industry. It is true that the consumers have contributed their quota in assenting to the restriction of imports, and that the government has invested £1,700,000, but the shareholders are entitled to expect, under normal conditions, an adequate return on the capital they invested. In all they have received a sum equivalent to two per cent. on the average share capital employed, but last year they were faced with a trading loss amounting to more than the total dividends previously paid. In such circumstances, the prospect of raising further capital is remote, and as trustees for the shareholders the directors are bound to shape their policy with a view to establishing the enterprise on a sound commercial basis before their subscribed capital has been expended. If rigid economy is exercised there is good reason to believe that success will ultimately be won. At present, despite the restricted demand for its products, it is understood that the corporation is paying its way. With a revival of trade it should do better than that, and might prudently set aside larger sums for development work. Mean-

while the first need is for greater efficiency in the commercial production of dyes in actual demand, and the second for the conservation of resources during an abnormal period. That is work for which men of business training are of greater value than men of scientific attainment, and the moment would not appear opportune for any change in the constitution of the board of directors.—*The London Times.*

SCIENTIFIC BOOKS

The Laws of Life: Principles of Evolution, Heredity and Eugenics. By WILLIAM M. GOLDSMITH, A. M., Ph.D. Boston, The Gorham Press, p. 441.

A LARGE, well-written and useful volume dealing particularly and most successfully with the problems of heredity in man and the conclusions based on our solutions of these problems.

Very many topics are treated by the author, in general sanely and accurately, with a wealth of illustrations and apt quotation. Much of this material ought to be part of the common knowledge of educated men and women, though at present this is far from the case. The main elements of eugenics especially should become as much a part of everyday knowledge as the causes of the succession of seasons—or even the multiplication table.

In the discussion of evolution, Dr. Goldsmith gives scant recognition to the theories and discoveries of Darwin. The conception of the formation of species largely by abrupt mutation and Mendelian hybridizing, is not borne out in nature, and in nature our species exist. A species of animal or plant is a definable type of organism which has run the gauntlet of the ages and has *endured.* The extrinsic facts and factors of evolution should not be ignored or minimized. We know nothing of evolution *in vacuo,* and the even flow of life is modified, obstructed or split by conditions of environment. Separation and selection are elements in the formation of every species, the one preserving adaptations, the other permitting, by new conditions of selection, the persistence of variations.

In spite of the researches of mechanistic experimenters, our author does not believe that all phenomena of life can be summed up in terms of chemistry or physics. It may be that he takes too much pains to reconcile religious conceptions with the facts of nature. Science deals with truth so far as we can understand it, and it is one of its basal principles that we can never know the answer to any question until we find it out.

DAVID STARR JORDAN
STANFORD UNIVERSITY, CALIFORNIA

SPECIAL ARTICLES

THE REST PERIOD OF SOLANUM TUBEROSUM IN RELATION TO AVAILABLE NITROGEN

EXPERIMENTAL evidence has been secured that the slow growth of potatoes planted during their rest period may be due in part to the deficiency of available nitrogen in the tubers.

On September 28, 1922, seed pieces, 25 grams in weight, from tubers in the resting condition were planted in pure silica sand. One half of the cultures were treated with a complete nutrient solution containing equal molal (.007 mol.) proportions of the following salts, KNO_3, $MgHPO_4$ and $CaSO_4$. The other half were treated with a solution of the same total molal concentration, but which was altered so as not to contain nitrates, the KNO_3 being replaced by KH_2PO_4. Six weeks later tubers which had passed through their rest period were planted in the same kind of medium. These cultures were treated like those above, *i.e.,* half received a complete nutrient solution and the other half a solution containing no nitrate. The cultures of both series, resting and non-resting tubers, that received a complete nutrient solution appeared above ground during the first week in December. The cultures from resting tubers that did not receive nitrate appeared above ground a week later than the cultures of the same series that received nitrate. An examination before the appearance of the first sprouts showed, however, that the time of sprouting was approximately the same in both cases. All the cultures of this series produced single sprouts. The outstanding feature of this series, however, was the rapid development of the sprouts in the cultures that received nitrate as compared with those that received no nitrate. At the end of several weeks the difference was still more striking, the cultures that received nitrate were large and healthy plants, while those that received no nitrate were barely above ground. The cultures of the second series, non-resting tubers, differed from the above in that four to six sprouts developed instead of one. There was no significant difference in the dates the sprouts appeared above ground due to the presence or absence of nitrate, and, furthermore, the plants grew equally well during their early growth phase whether or not they received nitrate.

It is evident that on germination the physiological condition of tubers planted during the rest period is not the same as in normal non-resting tubers. The results obtained suggest that the breaking of the rest period in potatoes may depend at least in part on the

presence of a readily soluble nitrogen supply. In the first series (resting tubers), this has been supplied in the form of nitrates. In the second series (non-resting tubers) this has been supplied by the tuber itself. This presumably may take place by the hydrolysis of the proteins by enzymes in the tuber. The presence of a proteolytic enzyme in expressed juice of potato tubers has been demonstrated by the writer, using centrifuged milk as a substrate. A survey of the literature available shows no record of the existence of proteolytic enzymes in the potato, although the assumption is general that they are present.

The effect of available nitrates upon potatoes planted while still in their rest period furnishes an explanation of the results obtained by Gericke,[1] who found that potato plants grown from resting tubers had a longer growing period than plants from non-resting tubers. The slow growth due to the possible inability of the young plants to obtain a sufficient supply of nitrogen during their early stages of growth would tend to lengthen their growing period.

Appleman's[2] conclusion is opposed to the above view. He found no significant evidence of the hydrolysis of the proteins during the rest period of potatoes. The experiments under way by the author to determine the relative proteolytic activity of potato tissue at various stages of the rest period and its effect upon the condition of the nitrogen compounds of the tuber, and the effect of the various treatments known to break the rest period, may furnish the required evidence. It is of interest to note that as early as 1890 Johannsen[3] found that ether treatment shortened the length of the rest period in bulbs and that the treatment seemed to increase the amount of amid nitrogen, although no other important chemical change appeared to occur. The experimental data on the above will be published at a later date.

W. NEWTON

UNIVERSITY OF CALIFORNIA

THE CANADIAN BRANCH OF THE AMERICAN PHYTOPATHOLOGICAL SOCIETY

THE fourth annual meeting of the Canadian Branch of the American Phytopathological Society was held in the biological laboratories and classrooms at MacDonald College, St. Anne de Bellevue, P. Q., December 7 and 8, 1922, in conjunction with the Quebec Society for the Protection of Plants. The address of welcome was given by Principal F. C. Harrison, and addresses were delivered by Professor William Lockhead, president of the Quebec Society for the Protection of Plants, and by G. E. McIntosh, Dominion Fruit Commissioner.

The following papers were read and discussed:

La campagne contre les sauterelles dans Quebec in 1922: G. MAHEUX.

Plant diseases of western Quebec in 1922: B. T. DICKSON.

The natural control of the green apple bug by a new species of Empusa: A. G. DUSTAN.

Control of the onion maggot in 1922: W. J. TAWSE.

The Dominion entomological service: A. GIBSON.

Disinfection et parcelles: O. CARON.

The pollination of certain vegetable plants by insects: R. C. TREHERNE.

Wood v. fungi (demonstration slides): R. J. BLAIR and J. D. HALE.

The past and future of plant pathology: MELVILLE T. COOK.

Report of the plant disease survey: F. L. DRAYTON.

Cultural characteristics of certain root-rot fusaria: T. G. MAJOR.

The present status of the white pine blister rust in Canada: A. W. MCCALLUM.

Red branch of conifers: J. H. FAULL.

Two plant diseases new to Ontario: J. E. HOWITT.

Control of oat smut: B. T. DICKSON, R. SUMMERBY and J. G. COULSON.

Five years' experiments in the control of oat smut: J. E. HOWITT and R. E. STONE.

Control of raspberry mosaic: J. F. HOCKEY.

Balsam rusts: H. P. BELL and J. H. FAULL.

Peony diseases: J. G. COULSON.

Root-rot and wilt of canning peas: R. E. STONE.

Distribution of ribes and cronartium ribicola in Ontario: G. H. DUFF.

Soft rot of iris: J. K. RICHARDSON.

Blue-stem of the black raspberry: J. F. HOCKEY.

Plant pathology in public schools: W. A. MCCUBBIN.

Smut control experiments with copper carbonate dust and other substances: P. M. SIMMONDS and W. P. FRASER.

Treatment of wounds in tree surgery: R. E. CORRETTE.

The bronze birch borer: C. B. HUTCHINGS.

Preservative treatment of farm timbers: J. H. CODERRE.

A contribution to our knowledge of the tree-destroying fungi of the Vancouver forestry district: N. L. CUTLER.

Abstracts of the papers dealing with plant diseases have appeared in a recent issue of *Phytopathology*. The address by Dr. M. T. Cook has appeared in full in the *Journal* of the Quebec Society for the Protection of Plants.

R. E. STONE,
Secretary-Treasurer

[1] Gericke, W. F., "Effects of rest and no rest upon growth in solanum," *Bot. Gaz.*, Vol. LXV, No. 4, April, 1918.

[2] Appleman, C. O., "Study of the rest period in potato tubers," Bulletin No. 183, Md. Exp. Sta., May, 1914.

[3] Johannsen, W., "Das Atherverfahren beim Fruhtreiben," 2 Auflage Jena, 1906.

SCIENCE NEWS

EXPEDITIONS OBSERVING THE ECLIPSE

Science Service

Astronomers from all over the world were stationed on Monday at advantageous points along a 100 mile wide strip in California and Mexico ready for the total eclipse of the sun. Massive and expensive telescopes, cameras and other apparatus were erected at advantageous points, corps of scientists were carefully drilled and many days were spent in preparation for the event. All this was done in order that the totally obscured sun might be observed for about three minutes.

Science goes to press before it is possible to receive any news of the results, but it may be of interest to give some information in regard to the location and plans of the various expeditions.

Point Loma, near San Diego, Cal.—The Mount Wilson Observatory's main eclipse observing station, equipped with two 30 foot cameras, one 15 foot camera, various telescopes and spectrographs, is located here under the direction of Dr. Walter S. Adams, director. Both the corona and the Einstein effect will be studied.

Leander McCormick Observatory of the University of Virginia has an expedition under the leadership of Dr. S. A. Mitchell, equipped with powerful Loucan grating spectrographs that are located near here at the center and edge of moon's shadow in order to determine the vapors constituting the sun's atmosphere and the height to which the vapors ascend. Two stations are being occupied for the purpose of photographing different layers of the solar atmosphere.

Prof. Charles Le Morvan heads a French expedition located here to study the sun during the eclipse.

Scientists from the Department of Terrestrial Magnetism of the Carnegie Institution will make elaborate magnetic observations in connection with Mount Wilson Observatory observations.

San Diego, Cal.—Army and Navy aviators are ready to attempt for the first time eclipse observation from airplanes. Lieut. John A. Macready, holder of the world's altitude record, and Lieut. A. W. Stevens, expert aerial photographer, plan to photograph surface features and the moon's shadow from an altitude of 20,000 feet. If clouds prevent observations from the surface, they will photograph the sun itself. Navy pilots at the request of the U. S. Naval Observatory will make photographs of the northern and southern edges of the path of the shadow cast on the earth during the eclipse to allow checking of computations of eclipse time. They will also photograph the "shadow bands" that pass across the landscape just before totality.

Santa Catalina Island, Cal.—An expedition from Yerkes Observatory of the University of Chicago, under direction of Dr. Edwin B. Frost, will make motion pictures of the eclipse, obtain large scale photographs of the corona with a 60 foot telescope, and make spectroscopic observations at a station located 1,300 feet above sea level. Santa Catalina Island is off the coast of California opposite Los Angeles.

Lakeside, Cal.—A second party from the Mount Wilson Observatory will study spectrum of gases in the sun's lower atmosphere.

Ensenada, Lower California, Mexico.—Lick Observatory of the University of California has an expedition located near here under the direction of Dr. W. W. Campbell, president and director. Observations will be concentrated on the corona problem and the party is equipped with large cameras, telescopes and spectrographs. Many of the astronomers connected with the party were members of the Lick Observatory, Australian expedition, that observed the eclipse of last year.

Lowell Observatory, located at Flagstaff, Ariz., will locate its party near here under the direction of Dr. V. M. Slipher, and extensive observations are contemplated.

Parties from the University of Indiana and De Pauw University will also be located here. Ensenada is 75 miles southeast of San Diego.

Hermosillo, Sonora, Mexico—A party headed by Dr. A. E. Douglass, director of the Steward Observatory, Tucson, Ariz., is located here with a five-inch lens of 39 feet focus and several other instruments. In the party are a number of amateur astronomers.

Yerbaniz, Mexico—The principal expedition from Mexican National Astronomical Observatory of Tacubaya, under direction of Prof. Joaquin Gallo, will photograph the sun's corona with two cameras of long focal length, and observe the sun's spectrum with special apparatus. A cinematographic camera will also be used. The personnel includes an engineer, calculator and mechanic.

Senor Rosendo Sandoval of the Mexican Magnetic Observatory will make special magnetic observations here.

Sproul Observatory of Swarthmore University has an expedition under the leadership of Dr. John A. Miller located here with its principal object the study of the corona of the sun. A camera of 65 foot focal length and other instruments are erected ready for the total eclipse. This expedition has taken out a policy for $10,000 insuring the securing of corona photographs of scientific value.

Yerbaniz is a small railroad station, located midway between Durango and Torreon.

Berrendo, Mexico—Second party from Mexican National Observatory is located here under direction of Prof. Jose Maria Chacon, who is accompanied by another astronomer, a mechanic, and Francisco Estanol, photographer and artist. Motion pictures will be taken and the artist will sketch the total eclipse. This party is also equipped with a photoheliograph and several telescope cameras. Berrendo, in the state of San Luis Potosi, is located a few kilometers north of Charcas in the same state.

Pasaje, Mexico—A German expedition under the leadership of Dr. Ludendorff, director of the Potsdam Observatory and brother of the general, assisted by Prof. Richardo Shorr, director of Bergedorf Observatory, and A. Kohlshutter, A. D. Dolberg and W. Herman, are en-

camped near this station where they will make extensive observations of the sun. Pasaje, near Cuencame, is a few kilometers north of Yerbanis.

Teoloyucan, Mexico—The Mexican Magnetic Observatory here will make special magnetic observations during the eclipse of the sun. Teoloyucan is twenty-two miles north of Mexico City.

PAST AND FUTURE ECLIPSES

Science Service

FAMOUS eclipses have been as follows:

Oct. 22, 2136 B. C. First recorded eclipse observed in China.

May 28, 585 B. C. First eclipse known to have been predicted, a mathematical feat performed by Thales of Miletus.

Aug. 30, 1030. Red light of corona of eclipsed sun frightened soldiers in battle at Stiklastad, Norway.

May 30, 1612. First eclipse seen "through a tube" or telescope.

October 27, 1780. First American eclipse expedition from Harvard University.

July 8, 1843. This eclipse marked the beginning of physical research on the sun.

July 28, 1851. First photograph of eclipse made in Germany.

Aug. 18, 1868. Janssen, French astronomer observing in India, determined from spectrum of solar prominences that they are enormous masses of highly heated gaseous matter. Observation revealed spectral line of helium, not discovered on earth until nearly thirty years later.

December 22, 1870. French astronomer, besieged in Paris, escaped by balloon carrying parts of telescope only to have observations spoiled by clouds. Prof. C. A. Young discovered "flash spectrum" and also line in corona spectrum attributed to hypothetical element "coronium."

May 29, 1919. Photographs by two British expeditions showed bending of light rays from stars as predicted by Einstein.

September 21, 1922. Lick Observatory party in Australia confirms Einstein effect.

Total obscurations of the sun during the next five years will take place:

Jan. 24, 1925, visible in New York City and eastern United States.

Jan. 14, 1926, visible in eastern Africa, Sumatra and Philippines.

June 29, 1927, visible in England and Scandinavia.

May 19, 1928, visible in Antarctic Ocean.

CAUSE OF THE JAPAN EARTHQUAKE

Science Service

THE devastating earthquake in Japan undoubtedly originated in part in the sea off the the coast of that island empire, Prof. Andrew C. Lawson, of the University of California, who has just gone to Washington to head the National Research Council's division on geology and geography, explained to a *Science Service* representative.

A great break in the ocean bottom occurred, allowing one side to slip past the other and drop for probably a dozen feet, carrying with it many millions of tons of sea water. The ocean rushing into the vacated space set up the so-called tidal waves that, oscillating back and forth like water in a tub, swept the Japanese coast. The violent shaking of the earth that caused destruction and started the fires was a result of the slipping of two portions of the earth's crust past each other.

The extremely deep portions of the oceans seem to be associated with the areas where earthquakes are most frequent, Prof. Lawson pointed out. Just off the east coast of Japan is a long depression in the ocean's floor called the "Tuscarora deep." Similar depths of the sea, found off Chile, the Philippines, Jamaica and the Aleutian Islands in Alaska are regions where earthquakes are frequent.

Earthquakes occur when strains in the earth's crust become too great and find relief in slips and breaks, Prof. Lawson said. He likened the crust to a board that when stressed by a weight will finally give way with a sudden crash. The rocks of the earth are elastic like steel and will stand a certain amount of strain before they are relieved by sudden movement.

Japan is noted for the progressive piling up of strains that result in earthquakes. Prof. Lawson recalled the quake of 1891 in Japan that left an abrupt cliff as high as eighteen feet in some parts of the zone.

Scientists know that there are various regions of the world, like Japan, the coast of California, the Alaskan coast, Chile and New Zealand, where the earth's surface is unstable and where adjustments are now in progress.

Eventually it may be possible for scientists to predict earthquakes, Prof. Lawson believes. Extensive investigations are now under way by the U. S. Coast and Geodetic Survey in California that show that there is a crustal creep there of about three feet in ten years relatively to the Sierra Nevadas. Several years ago the National Research Council pointed out the need of seismologic study and the Carnegie Institution with the cooperation of other scientific bodies is making an intensive study of California, which was selected because of the work previously done on the San Francisco earthquake of 1906. The U. S. Coast and Geodetic Survey has had survey parties in the field for the last two years to determine the rate of movement there. Prof. Lawson considers this slow displacement as a strain creep, which accumulates till relief is effected by a sudden slip or a rupture in the earth's crust.

"After years more of such research," said Prof. Lawson, "I believe that it may be possible to predict about when the strains that are indicated by these movements will be released and cause an earthquake, but exact prediction is not likely to be obtained. We can not draw conclusions from our present data because we do not know how earthquakes, often very slight in one part of the area, affect the strains in another part."

The deep-seated reason for earthquakes remains a mystery to science. The most plausible theory, according to Prof. Lawson, is that deep in the earth the rocks, while remaining hard and very dense, act like a fluid and tend

SCIENCE

VOL. LVIII SEPTEMBER 21, 1928 No. 1499

CONTENTS

SCIENCE: A Weekly Journal devoted to the Advancement of Science, edited by J. McKeen Cattell and published every Friday by

THE SCIENCE PRESS

Lancaster, Pa. Garrison, N. Y.

New York City: Grand Central Terminal.

Annual Subscription, $6.00. Single Copies, 15 Cts.

SCIENCE is the official organ of the American Association for the Advancement of Science. Information regarding membership in the association may be secured from the office of the permanent secretary, in the Smithsonian Institution Building, Washington, D. C.

Entered as second-class matter July 18, 1923, at the Post Office at Lancaster, Pa., under the Act of March 3, 1879.

THE ELECTRICAL STRUCTURE OF MATTER[1]

IT was in 1896 that this Association last met in Liverpool, under the presidency of the late Lord Lister, that great pioneer in antiseptic surgery, whose memory is held in affectionate remembrance by all nations. His address, which dealt mainly with the history of the application of antiseptic methods to surgery and its connection with the work of Pasteur, that prince of experimenters, whose birth has been so fittingly celebrated this year, gave us in a sense a completed page of brilliant scientific history. At the same time, in his opening remarks, Lister emphasized the importance of the discovery by Röntgen of a new type of radiation, the x-rays, which we now see marked the beginning of a new and fruitful era in another branch of science.

The visit to your city in 1896 was for me a memorable occasion, for it was here that I first attended a meeting of this Association, and here that I read my first scientific paper. But of much more importance, it was here that I benefited by the opportunity, which these gatherings so amply afford, of meeting for the first time many of the distinguished scientific men of this country and the foreign representatives of science who were the guests of this city on that occasion. The year 1896 has always seemed to me a memorable one for other reasons, for on looking back with some sense of perspective we can not fail to recognize that the last Liverpool meeting marked the beginning of what has been aptly termed the heroic age of physical science. Never before in the history of physics has there been witnessed such a period of intense activity when discoveries of fundamental importance have followed one another with such bewildering rapidity.

The discovery of x-rays by Röntgen had been published to the world in 1895, while the discovery of the radioactivity of uranium by Becquerel was announced early in 1896. Even the most imaginative of our scientific men could never have dreamed at that time of the extension of our knowledge of the structure of matter that was to develop from these two fundamental discoveries, but in the records of the Liverpool meeting we see the dawning recognition of the possible consequences of the discovery of x-rays, not only in their application to medicine and surgery,

[1] The presidential address before the British Association for the Advancement of Science given at Liverpool on September 12.

but as a new and powerful agent for attacking some of the fundamental problems of physics. The address of Professor J. J. Thomson, president of Section A, was devoted mainly to a discussion of the nature of the x-rays, and the remarkable properties induced in gases by the passage of x-rays through them—the beginning of a new and fruitful branch of study.

In applied physics, too, this year marked the beginning of another advance. In the discussion of a paper which I had the honor to read, on a new magnetic detector of electrical waves, the late Sir William Preece told the meeting of the successful transmission of signals for a few hundred yards by electric waves which had been made in England by a young Italian, G. Marconi. The first public demonstration of signalling for short distances by electric waves had been given by Sir Oliver Lodge at the Oxford Meeting of this association in 1894. It is startling to recall the rapidity of the development from such small beginnings of the new method of wireless intercommunication over the greatest terrestrial distances. In the last few years this has been followed by the even more rapid growth of the allied subject of radiotelephony as a practical means of broadcasting speech and music to distances only limited by the power of the transmitting station. The rapidity of these technical advances is an illustration of the close interconnection that must exist between pure and applied science if rapid and sure progress is to be made. The electrical engineer has been able to base his technical developments on the solid foundation of Maxwell's electromagnetic theory and its complete verification by the researches of Hertz, and also by the experiments of Sir Oliver Lodge in this university—a verification which was completed long before the practical possibilities of this new method of signalling had been generally recognized. The later advances in radiotelegraphy and radiotelephony have largely depended on the application of the results of fundamental researches on the properties of electrons, as illustrated in the use of the thermionic valve or electron tube which has proved such an invaluable agent both for the transmission and reception of electric waves.

It is of great interest to note that the benefits of this union of pure and applied research have not been one-sided. If the fundamental researches of the workers in pure science supply the foundations on which the applications are surely built, the successful practical application in turn quickens and extends the interest of the investigator in the fundamental problem, while the development of new methods and appliances required for technical purposes often provides the investigator with means of attacking still more difficult questions. This important reaction between pure and applied science can be illustrated in many branches of knowledge. It is particularly manifest in the industrial development of x-ray radiography for therapeutic and industrial purposes, where the development on a large scale of special x-ray tubes and improved methods of excitation has given the physicist much more efficient tools to carry out his researches on the nature of the rays themselves and on the structure of the atom. In this age no one can draw any sharp line of distinction between the importance of so-called pure and applied research. Both are equally essential to progress, and we can not but recognise that without flourishing schools of research on fundamental matters in our universities and scientific institutions technical research must tend to wither. Fortunately there is little need to labor this point at the moment, for the importance of a training in pure research has been generally recognised. The Department of Scientific and Industrial Research has made a generous provision of grants to train qualified young men of promise in research methods in our scientific institutions, and has aided special fundamental researches which are clearly beyond the capacity of a laboratory to finance from its own funds. Those who have the responsibility of administering the grants in aid of research both for pure and applied science will need all their wisdom and experience to make a wise allocation of funds to secure the maximum of results for the minimum of expenditure. It is fatally easy to spend much money in a direct frontal attack on some technical problem of importance when the solution may depend on some addition to knowledge which can be gained in some other field of scientific inquiry possibly at a trifling cost. It is not in any sense my purpose to criticise those bodies which administer funds for fostering pure and applied research, but to emphasise how difficult it is to strike the correct balance between the expenditure on pure and applied science in order to achieve the best results in the long run.

It is my intention this evening to refer very briefly to some of the main features of that great advance in knowledge of the nature of electricity and matter which is one of the salient features of the interval since the last meeting of this Association in Liverpool.

In order to view the extensive territory which has been conquered by science in this interval, it is desirable to give a brief summary of the state of knowledge of the constitution of matter at the beginning of this epoch. Ever since its announcement by Dalton the atomic theory has steadily gained ground, and formed the philosophic basis for the explanation of the facts of chemical combination. In the early stages of its application to physics and chemistry it was unnecessary to have any detailed knowledge of the dimensions or structure of the atom. It was only necessary to assume that the atoms acted as individual units, and to know the relative masses of the atoms

of the different elements. In the next stage, for example, in the kinetic theory of gases, it was possible to explain the main properties of gases by supposing that the atoms of the gas acted as minute perfectly elastic spheres. During this period, by the application of a variety of methods, many of which were due to Lord Kelvin, rough estimates had been obtained of the absolute dimensions and mass of the atoms. These brought out the minute size and mass of the atom and the enormous number of atoms necessary to produce a detectable effect in any kind of measurement. From this arose the general idea that the atomic theory must of necessity forever remain unverifiable by direct experiment, and for this reason it was suggested by one school of thought that the atomic theory should be banished from the teaching of chemistry, and that the law of multiple proportions should be accepted as the ultimate fact of chemistry.

While the vaguest ideas were held as to the possible structure of atoms, there was a general belief among the more philosophically minded that the atoms of the elements could not be regarded as simple unconnected units. The periodic variations of the properties of the elements brought out by Mendeléef were only explicable if atoms were similar structures in some way constructed of similar material. We shall see that the problem of the constitution of atoms is intimately connected with our conception of the nature of electricity. The wonderful success of the electromagnetic theory had concentrated attention on the medium or ether surrounding the conductor of electricity, and little attention had been paid to the actual carriers of the electric current itself. At the same time the idea was generally gaining ground that an explanation of the results of Faraday's experiments on electrolysis was only possible on the assumption that electricity, like matter, was atomic in nature. The name "electron" had even been given to this fundamental unit by Johnstone Stoney, and its magnitude roughly estimated, but the full recognition of the significance and importance of this conception belongs to the new epoch.

For the clarifying of these somewhat vague ideas, the proof in 1897 of the independent existence of the electron as a mobile electrified unit, of mass minute compared with that of the lightest atom, was of extraordinary importance. It was soon seen that the electron must be of a constituent of all the atoms of matter, and that optical spectra had their origin in their vibrations. The discovery of the electron and the proof of its liberation by a variety of methods from all the atoms of matter was of the utmost significance, for it strengthened the view that the electron was probably the common unit in the structure of atoms which the periodic variation of the chemical properties had indicated. It gave for the first time some hope of the success of an attack on that most fundamental of all problems—the detailed structure of the atom. In the early development of this subject science owes much to the work of Sir. J. J. Thomson, both for the boldness of his ideas and for his ingenuity in developing methods for estimating the number of electrons in the atom, and of probing its structure. He early took the view that the atom must be an electrical structure, held together by electrical forces, and showed in a general way lines of possible explanation of the variation of physical and chemical properties of the elements, exemplified in the periodic law.

In the meantime our whole conception of the atom and of the magnitude of the forces which held it together were revolutionized by the study of radioactivity. The discovery of radium was a great step in advance, for it provided the experimenter with powerful sources of radiation specially suitable for examining the nature of the characteristic radiations which are emitted by the radioactive bodies in general. It was soon shown that the atoms of radioactive matter were undergoing spontaneous transformation, and that the characteristic radiations emitted, *viz.*, the α, β and γ rays, were an accompaniment and consequence of these atomic explosions. The wonderful succession of changes that occur in uranium, more than thirty in number, was soon disclosed and simply interpreted on the transformation theory. The radioactive elements provide us for the first time with a glimpse into Nature's laboratory, and allow us to watch and study but not control the changes that have their origin in the heart of the radioactive atoms. These atomic explosions involve energies which are gigantic compared with those involved in any ordinary physical or chemical process. In the majority of cases an α particle is expelled at high speed, but in others a swift electron is ejected often accompanied by a γ ray, which is a very penetrating x-ray of high frequency. The proof that the α particle is a charged helium atom for the first time disclosed the importance of helium as one of the units in the structure of the radioactive atoms, and probably also in that of the atoms of most of the ordinary elements. Not only then have the radioactive elements had the greatest direct influence on natural philosophy, but in subsidiary ways they have provided us with experimental methods of almost equal importance. The use of α particles as projectiles with which to explore the interior of the atom has definitely exhibited its nuclear structure, has led to artificial disintegration of certain light atoms, and promises to yield more information yet as to the actual structure of the nucleus itself.

The influence of radioactivity has also extended to yet another field of study of fascinating interest. We

have seen that the first rough estimates of the size and mass of the atom gave little hope that we could detect the effect of a single atom. The discovery that the radioactive bodies expel actual charged atoms of helium with enormous energy altered this aspect of the problem. The energy associated with a single α particle is so great that it can readily be detected by a variety of methods. Each α particle, as Sir Wm. Crookes first showed, produces a flash of light easily visible in a dark room when it falls on a screen coated with crystals of zinc sulphide. This *scintillation* method of counting individual particles has proved invaluable in many researches, for it gives us a method of unequalled delicacy for studying the effects of single atoms. The α particle can also be detected electrically or photographically, but the most powerful and beautiful of all methods is that perfected by Mr. C. T. R. Wilson for observing the track through a gas not only of an α particle but of any type of penetrating radiation which produces ions or of electrified particles along its path. The method is comparatively simple, depending on the fact, first discovered by him, that if a gas saturated with moisture is suddenly cooled each of the ions produced by the radiation becomes the nucleus of a visible drop of water. The water-drops along the track of the α particle are clearly visible to the eye, and can be recorded photographically. These beautiful photographs of the effect produced by single atoms or single electrons appeal, I think, greatly to all scientific men. They not only afford convincing evidence of the discrete nature of these particles, but give us new courage and confidence that the scientific methods of experiment and deduction are to be relied upon in this field of inquiry; for many of the essential points brought out so clearly and concretely in these photographs were correctly deduced long before such confirmatory photographs were available. At the same time, a minute study of the detail disclosed in these photographs gives us most valuable information and new clues on many recondite effects produced by the passage through matter of these flying projectiles and penetrating radiations.

In the meantime a number of new methods had been devised to fix with some accuracy the mass of the individual atom and the number in any given quantity of matter. The concordant results obtained by widely different physical principles gave great confidence in the correctness of the atomic idea of matter. The method found capable of most accuracy depends on the definite proof of the atomic nature of electricity and the exact valuation of this fundamental unit of charge. We have seen that it was early surmised that electricity was atomic in nature. This view was confirmed and extended by a study of the charges carried by electrons, α particles, and the ions produced in gases by x-rays and the rays from radioactive matter. It was first shown by Townsend that the positive or negative charge carried by an ion in gases was invariably equal to the charge carried by the hydrogen ion in the electrolysis of water, which we have seen was assumed, and assumed correctly, by Johnstone Stoney to be the fundamental unit of charge. Various methods were devised to measure the magnitude of this fundamental unit; the best known and most accurate is Millikan's, which depends on comparing the pull of an electric field on a charged droplet of oil or mercury with the weight of the drop. His experiments gave a most convincing proof of the correctness of the electronic theory, and gave a measure of this unit, the most fundamental of all physical units, with an accuracy of about one in a thousand. Knowing this value, we can by the aid of electro-chemical data easily deduce the mass of the individual atoms and the number of molecules in a cubic centimeter of any gas with an accuracy of possibly one in a thousand, but certainly better than one in a hundred. When we consider the minuteness of the unit of electricity and of the mass of the atom this experimental achievement is one of the most notable even in an era of great advances.

The idea of the atomic nature of electricity is very closely connected with the attack on the problem of the structure of the atom. If the atom is an electrical structure it can only contain an integral number of charged units, and, since it is ordinarily neutral, the number of units of positive charge must equal the number of negative. One of the main difficulties in this problem has been the uncertainty as to the relative part played by positive and negative electricity in the structure of the atom. We know that the electron has a negative charge of one fundamental unit, while the charged hydrogen atom, whether in electrolysis or in the electric discharge, has a charge of one positive unit. But the mass of the electron is only 1/1840 of the mass of the hydrogen atom, and though an extensive search has been made, not the slightest evidence has been found of the existence of a positive electron of small mass like the negative. In no case has a positive charge been found associated with a mass less than that of the charged atom of hydrogen. This difference between positive and negative electricity is at first sight very surprising, but the deeper we pursue our inquiries the more this fundamental difference between the units of positive and negative electricity is emphasized. In fact, as we shall see later, the atoms are quite unsymmetrical structures with regard to the positive and negative units contained in them, and indeed it seems certain that if there were not this difference in mass between the two units, matter, as we know it, could not exist.

It is natural to inquire what explanation can the

given of this striking difference in mass of the two units. I think all scientific men are convinced that the small mass of the negative electron is to be entirely associated with the energy of its electrical structure, so that the electron may be regarded as a disembodied atom of negative electricity. We know that an electron in motion, in addition to possessing an electric field, also generates a magnetic field around it, and energy in the electromagnetic form is stored in the medium and moves with it. This gives the electron an apparent or electrical mass, which, while nearly constant for slow speeds, increases rapidly as its velocity approaches that of light. This increase of mass is in good accord with calculation, whether based on the ordinary electrical theory or on the theory of relativity. Now we know that the hydrogen atom is the lightest of all atoms, and is presumably the simplest in structure, and that the charged hydrogen atom, which we shall see is to be regarded as the hydrogen nucleus, carries a unit positive charge. It is thus natural to suppose that the hydrogen nucleus is the atom of positive electricity, or positive electron, analogous to the negative electron, but differing from it in mass. Electrical theory shows that the mass of a given charge of electricity increases with the concentration, and the greater mass of the hydrogen nucleus would be accounted for if its size were much smaller than that of the electron. Such a conclusion is supported by evidence obtained from the study of the close collisions of α particles with hydrogen nuclei. It is found that the hydrogen nucleus must be of minute size, of radius less than the electron, which is usually supposed to be about 10^{-13} cms.; also the experimental evidence is not inconsistent with the view that the hydrogen nucleus may actually be much smaller than the electron. While the greater mass of the positive atom of electricity may be explained in this way, we are still left with the enigma why the two units of electricity should differ so markedly in this respect. In the present state of our knowledge it does not seem possible to push this inquiry further, or to discuss the problem of the relation of these two units.

We shall see that there is the strongest evidence that the atoms of matter are built up of these two electrical units, *viz.*, the electron and the hydrogen nucleus or proton, as it is usually called when it forms part of the structure of any atom. It is probable that these two are the fundamental and indivisible units which build up our universe, but we may reserve in our mind the possibility that further inquiry may some day show that these units are complex, and divisible into even more fundamental entities. On the views we have outlined the mass of the atom is the sum of the electrical masses of the individual charged units composing its structure, and there is no need to assume that any other kind of mass exists. At the same time, it is to be borne in mind that the actual mass of an atom may be somewhat less than the sum of the masses of component positive and negative electrons when in the free state. On account of the very close proximity of the charged units in the nucleus of an atom, and the consequent disturbance of the electric and magnetic field surrounding them, such a decrease of mass is to be anticipated on general theoretical grounds.

We must now look back again to the earlier stages of the present epoch in order to trace the development of our ideas on the detailed structure of the atom. That electrons as such were important constituents was clear by 1900, but little real progress followed until the part played by the positive charges was made clear. New light was thrown on this subject by examining the deviation of α particles when they passed through the atoms of matter. It was found that occasionally a swift α particle was deflected from its rectilinear path through more than a right angle by an encounter with a single atom. In such a collision the laws of dynamics ordinarily apply, and the relation between the velocities of the colliding atoms before and after collision are exactly the same as if the two colliding particles are regarded as perfectly elastic spheres of minute dimensions. It must, however, be borne in mind that in these atomic collisions there is no question of mechanical impacts such as we observe with ordinary matter. The reaction between the two particles occurs through the intermediary of the powerful electric fields that surround them. Beautiful photographs illustrating the accuracy of these laws of collision between an α particle and an atom have been obtained by Messrs. Wilson, Blackett and others, while Mr. Wilson has recently obtained many striking illustrations of collisions between two electrons. Remembering the great kinetic energy of the α particle, its deflection through a large angle in a single atomic encounter shows clearly that very intense deflecting forces exist inside the atom. It seemed clear that electric fields of the required magnitude could be obtained only if the main charge of the atom were concentrated in a minute nucleus. From this arose the conception of the nuclear atom, now so well known, in which the heart of the atom is supposed to consist of a minute but massive nucleus, carrying a positive charge of electricity, and surrounded at a distance by the requisite number of electrons to form a neutral atom.

A detailed study of the scattering of α particles at different angles, by Geiger and Marsden, showed that the results were in close accord with this theory, and that the intense electric forces near the nucleus varied according to the ordinary inverse square law. In addition, the experiments allowed us to fix an upper

limit for the dimensions of the nucleus. For a heavy atom like that of gold the radius of the nucleus, if supposed to be spherical, was less than one thousandth of the radius of the complete atom surrounded by its electrons, and certainly less than 4×10^{-12} cms. All the atoms were found to show this nuclear structure, and an approximate estimate was made of the nuclear charge of different atoms. This type of nuclear atom, based on direct experimental evidence, possesses some very simple properties. It is obvious that the number of units of resultant positive charge in the nucleus fixes the number of the outer planetary electrons in the neutral atom. In addition, since these outer electrons are in some way held in equilibrium by the attractive forces from the nucleus, and, since we are confident from general physical and chemical evidence that all atoms of any one element are identical in their external structure, it is clear that their arrangement and motion must be governed entirely by the magnitude of the nuclear charge. Since the ordinary chemical and physical properties are to be ascribed mainly to the configuration and motion of the outer electrons, it follows that the properties of an atom are defined by a whole number representing its nuclear charge. It thus becomes of great importance to determine the value of this nuclear charge for the atoms of all the elements.

Data obtained from the scattering of α particles, and also from the scattering of x-rays by light elements, indicated that the nuclear charge of an element was numerically equal to about half the atomic weight in terms of hydrogen. It was fairly clear from general evidence that the hydrogen nucleus had a charge one, and the helium nucleus (the α particle) a charge two. At this stage another discovery of great importance provided a powerful method of attack on this problem. The investigation by Laue on the diffraction of x-rays by crystals had shown definitely that x-rays were electromagnetic waves of much shorter wave-length than light, and the experiments of Sir William Bragg and W. L. Bragg had provided simple methods for studying the spectra of a beam of x-rays. It was found that the spectrum in general shows a continuous background on which is superimposed a spectrum of bright lines. At this stage H. G. J. Moseley began a research with the intention of deciding whether the properties of an element depended on its nuclear charge rather than on its atomic weight as ordinarily supposed. For this purpose the x-ray spectra emitted by a number of elements were examined and found to be all similar in type. The frequency of a given line was found to vary very nearly as the square of a whole number which varied by unity in passing from one element to the next. Moseley identified this whole number with the atomic or ordinal number of the elements when arranged in increasing order of atomic weight, allowance being made for the known anomalies in the periodic table and for certain gaps corresponding to possible but missing elements. He concluded that the atomic number of an element was a measure of its nuclear charge, and the correctness of this deduction has been recently verified by Chadwick by direct experiments on the scattering of α particles. Moseley's discovery is of fundamental importance, for it not only fixes the number of electrons in all the atoms, but shows conclusively that the properties of an atom, as had been surmised, are determined not by its atomic weight but by its nuclear charge. A relation of unexpected simplicity is thus found to hold between the elements. No one could have anticipated that with few exceptions all atomic numbers between hydrogen 1, and uranium 92, would correspond to known elements. The great power of Moseley's law in fixing the atomic number of an element is well illustrated by the recent discovery by Coster and Hevesy in Copenhagen of the missing element of atomic number 72, which they have named "hafnium."

Once the salient features of the structure of atoms have been fixed and the number of electrons known, the further study of the structure of the atom falls naturally into two great divisions: one, the arrangement of the outer electrons which controls the main physical and chemical properties of an element, and the other the structure of the nucleus on which the mass and radioactivity of the atom depends. On the nuclear theory the hydrogen atom is of extreme simplicity, consisting of a singly-charged positive nucleus, with only one attendant electron. The positions and motions of the single electron must account for the complicated optical spectrum, and whatever physical and chemical properties are to be attributed to the hydrogen atom. The first definite attack on the problem of the electronic structure of the atom was made by Niels Bohr. He saw clearly that, if this simple constitution was assumed, it is impossible to account for the spectrum of hydrogen on the classical electrical theories, but that a radical departure from existing views was necessary. For this purpose he applied to the atom the essential ideas of the quantum theory which had been developed by Planck for other purposes, and had been found of great service in explaining many fundamental difficulties in other branches of science. On Planck's theory radiation is emitted in definite units or quanta, in which the energy E of a radiation is equal to $h\nu$ where ν is the frequency of the radiation measured by the ordinary methods and h a universal constant. This quantum of radiation is not a definite fixed unit like the atom of electricity, for its magnitude depends on the frequency of the radiation. For example, the energy of a quantum is small for visible light, but becomes large for radiation of high frequency corresponding to the x-rays or the γ rays from radium.

Time does not allow me to discuss the underlying

meaning of the quantum theory or the difficulties connected with it. Certain aspects of the difficulties were discussed in the presidential address before this association by Sir Oliver Lodge at Birmingham in 1913. It suffices to say that this theory has proved of great value in several branches of science, and is supported by a large mass of direct experimental evidence.

In applying the quantum theory to the structure of the hydrogen atom Bohr supposed that the single electron could move in a number of stable orbits, controlled by the attractive force of the nucleus, without losing energy by radiation. The position and character of these orbits were defined by certain quantum relations depending on one or more whole numbers. It was assumed that radiation was only emitted when the electron for some reason was transferred from one stable orbit to another of lower energy. In such a case it was supposed that a homogeneous radiation was emitted of frequency ν determined by the quantum relation $E = h\nu$ where E was the difference of the energy of the electron in the two orbits. Some of these possible orbits are circular, others elliptical, with the nucleus as a focus, while if the change of mass of the electron with velocity is taken into account the orbits, as Sommerfeld showed, depend on two quantum numbers, and are not closed, but consist of a nearly elliptical orbit slowly rotating round the nucleus. In this way it is possible not only to account for the series relations between the bright lines of the hydrogen spectrum, but also to explain the fine structure of the lines and the very complicated changes observed when the radiating atoms are exposed in a strong magnetic or electric field. Under ordinary conditions the electron in the hydrogen atom rotates in a circular orbit close to the nucleus, but if the atoms are excited by an electric discharge or other suitable method, the electron may be displaced and occupy any one of the stable positions specified by the theory. In a radiating gas giving the complete hydrogen spectrum there will be present many different kinds of hydrogen atoms, in each of which the electron describes one of the possible orbits specified by the theory. On this view it is seen that the variety of modes of vibration of the hydrogen atom is ascribed, not to complexity of the structure of the atom, but to the variety of stable orbits which an electron may occupy relative to the nucleus. This novel theory of the origin of spectra has been developed so as to apply not only to hydrogen but to all the elements, and has been instrumental in throwing a flood of light on the relations and origin of their spectra, both X-ray and optical. The information thus gained has been applied by Bohr to determine the distribution of the electrons round the nucleus of any atom. The problem is obviously much less complicated for hydrogen than for a heavy atom, where each of the large number of electrons present acts on the other, and where the orbits described are much more intricate than the orbit of the single electron in hydrogen. Notwithstanding the great difficulties of such a complicated system of electrons in motion, it has been possible to fix the quantum numbers that characterize the motion of each electron, and to form at any rate a rough idea of the character of the orbit.

These planetary electrons divide themselves up into groups, according as their orbits are characterized by one or more equal quantum numbers. Without going into detail a few examples may be given to illustrate the conclusions which have been reached. As we have seen, the first element hydrogen has a nuclear charge of 1 and 1 electron; the second, helium, has a charge 2 and 2 electrons, moving in coupled orbits on the detailed nature of which there is still some uncertainty. These two electrons form a definite group, known as the K group, which is common to all the elements except hydrogen. For increasing nuclear charge the K group of electrons retain their characteristics, but move with increasing speed, and approach closer to the nucleus. As we pass from helium of atomic number 2 to neon, number 10, a new group of electrons is added consisting of two sub-groups, each of four electrons, together called the L group. This L group appears in all atoms of higher atomic number, and, as in the case of the K group, the speed of motion of the electrons increases, and the size of their orbits diminishes with the atomic number. When once the L group has been completed a new and still more complicated M group of electrons begins forming outside it, and a similar process goes on until uranium, which has the highest atomic number, is reached.

It may be of interest to try to visualize the conception of the atom we have so far reached by taking for illustration the heaviest atom, uranium. At the center of the atom is a minute nucleus surrounded by a swirling group of 92 electrons, all in motion in definite orbits, and occupying but by no means filling a volume very large compared with that of the nucleus. Some of the electrons describe nearly circular orbits round the nucleus; others, orbits of a more elliptical shape whose axes rotate rapidly round the nucleus. The motion of the electrons in the different groups is not necessarily confined to a definite region of the atom, but the electrons of one group may penetrate deeply into the region mainly occupied by another group, thus giving a type of interconnection or coupling between the various groups. The maximum speed of any electron depends on the closeness of the approach to the nucleus, but the outermost electron will have a minimum speed of more than 1,000 kilometers per second, while the innermost K electrons have an average speed of more than 150,-

000 kilometers per second, or half the speed of light. When we visualize the extraordinary complexity of the electronic system we may be surprised that it has been possible to find any order in the apparent medley of motions.

In reaching these conclusions, which we owe largely to Professor Bohr and his co-workers, every available kind of data about the different atoms has been taken into consideration. A study of the X-ray spectra, in particular, affords information of great value as to the arrangement of the various groups in the atom, while the optical spectrum and general chemical properties are of great importance in deciding the arrangements of the superficial electrons. While the solution of the grouping of the electrons proposed by Bohr has been assisted by considerations of this kind, it is not empirical in character, but has been largely based on general theoretical considerations of the orbits of electrons that are physically possible on the generalized quantum theory. The real problem involved may be illustrated in the following way. Suppose the gold nucleus be in some way stripped of its attendant seventy-nine electrons and that the atom is reconstituted by the successive addition of electrons one by one. According to Bohr, the atom will be reorganized in one way only, and one group after another will successively form and be filled up in the manner outlined. The nucleus atom has often been likened to a solar system where the sun corresponds to the nucleus and the planets to the electrons. The analogy, however, must not be pressed too far. Suppose, for example, we imagined that some large and swift celestial visitor traverses and escapes from our solar system without any catastrophe to itself or the planets. There will inevitably result permanent changes in the lengths of the month and year, and our system will never return to its original state. Contrast this with the effect of shooting an electron or α particle through the electronic structure of the atom. The motion of many of the electrons will be disturbed by its passage, and in special cases an electron may be removed from its orbit and hurled out of its atomic system. In a short time another electron will fall into the vacant place from one of the outer groups, and this vacant place in turn will be filled up, and so on until the atom is again reorganized. In all cases the final state of the electronic system is the same as in the beginning. This illustration also serves to indicate the origin of the X-rays excited in the atom, for these arise in the process of reformation of an atom from which an electron has been ejected, and the radiation of highest frequency arises when the electron is removed from the K group.

It is possibly too soon to express a final opinion on the accuracy of this theory which defines the outer structure of the atom, but there can be no doubt that it constitutes a great advance. Not only does it offer a general explanation of the optical and x-ray spectra of the atom, but it accounts in detail for many of the most characteristic features of the periodic law of Mendeléef. It gives us for the first time a clear idea of the reason for the appearance in the family of elements of groups of consecutive elements with similar chemical properties, such as the groups analogous to the iron group and the unique group of rare earths. The theory of Bohr, like all living theories, has not only correlated a multitude of isolated facts known about the atom, but has shown its power to predict new relations which can be verified by experiment. For example, the theory predicted the relations which must subsist between the Rydberg constants of the arc and spark spectra, and generally between all the successive optical spectra of an element, a prediction so strikingly confirmed by Paschen's work on the spectrum of doubly ionized aluminium and Fowler's work on the spectrum of trebly ionized silicon. Finally, it predicted with such great confidence the chemical properties of the missing element, number 72, that it gave the necessary incentive for its recent discovery.

While the progress of our knowledge of the outer structure of atoms has been much more rapid than could have been anticipated, we clearly see that only a beginning has been made on this great problem, and that an enormous amount of work is still required before we can hope to form anything like a complete picture even of the outer structure of the atom. We may be confident that the main features of the structure are clear, but in a problem of such great complexity progress in detail must of necessity be difficult and slow.

We have not so far referred to the very difficult question of the explanation on this theory of the chemical combination of atoms. In fact, as yet the theory has hardly concerned itself with molecular structure. On the chemical side, however, certain advances have already been made, notably by G. N. Lewis, Kossel, and Langmuir, in the interpretation of the chemical evidence by the idea of shared electrons, which play a part in the electronic structure of two combined atoms. There can be little doubt that the next decade will see an intensified attack by physicists and chemists on this very important but undoubtedly very complicated question.

Before leaving this subject, it may be of interest to refer to certain points in Bohr's theory of a more philosophical nature. It is seen that the orbits and energies of the various groups of electrons can be specified by certain quantum numbers, and the nature of the radiation associated with a change of orbit can be defined. But at the same time we can not explain why these orbits are alone permissible under normal

conditions, or understand the mechanism by which radiation is emitted. It may be quite possible to formulate accurately the energy relation of the electrons in the atom on a simple theory, and to explain in considerable detail all the properties of an atom, without any clear understanding of the underlying processes which lead to these results. It is natural to hope that with advance of knowledge we may be able to grasp the details of the process which leads to the emission of radiation, and to understand why the orbits of the electrons in the atom are defined by the quantum relations. Some, however, are inclined to take the view that in the present state of knowledge it may be quite impossible in the nature of things to form that detailed picture in space and time of successive events that we have been accustomed to consider as so important a part of a complete theory. The atom is naturally the most fundamental structure presented to us. Its properties must explain the properties of all more complicated structures, including matter in bulk, but we may not, therefore, be justified in expecting that its processes can be explained in terms of concepts derived entirely from a study of molar properties. The atomic processes involved may be so fundamental that a complete understanding may be denied us. It is early yet to be pessimistic on this question, for we may hope that our difficulties may any day be resolved by further discoveries.

We must now turn our attention to that new and comparatively unexplored territory, the nucleus of the atom. In a discussion on the structure of the atom ten years ago, in answer to a question on the structure of the nucleus, I was rash enough to say that it was a problem that might well be left to the next generation, for at that time there seemed to be few obvious methods of attack to throw light on its constitution. While much more progress has been made than appeared possible at that time, the problem of the structure of the nucleus is inherently more difficult than the allied problem already considered of the structure of the outer atom, where we have a wealth of information obtained from the study of light and x-ray spectra and from the chemical properties to test the accuracy of our theories.

In the case of the nucleus, we know its resultant charge, fixed by Moseley's law, and its mass, which is very nearly equal to the mass of the whole atom, since the mass of the planetary electrons is relatively very small and may for most purposes be neglected. We know that the nucleus is of size minute compared with that of the whole atom, and can with some confidence set a maximum limit to its size. The study of radioactive bodies has provided us with very valuable information on the structure of the nucleus, for we know that the α and β particles must be expelled from it, and there is strong evidence that the very penetrating γ rays represent modes of vibration of the electrons contained in its structure. In the long series of transformations which occur in the uranium atom, eight α particles are emitted and six electrons, and it seems clear that the nucleus of a heavy atom is built up, in part at least, of helium nuclei and electrons. It is natural to suppose that many of the ordinary stable atoms are constituted in a similar way. It is a matter of remark that no indication has been obtained that the lightest nucleus, *viz.*, that of hydrogen, is liberated in these transformations, where the processes occurring are of so fundamental a character. At the same time, it is evident that the hydrogen nucleus must be a unit in the structure of some atoms, and this has been confirmed by direct experiment. Dr. Chadwick and I have observed that swift hydrogen nuclei are released from the elements boron, nitrogen, fluorine, sodium, aluminium, and phosphorus when they are bombarded by swift α particles, and there is little room for doubt that these hydrogen nuclei form an essential part of the nuclear structure. The speed of ejection of these nuclei depends on the velocity of the α particle and on the element bombarded. It is of interest to note that the hydrogen nuclei are liberated in all directions, but the speed in the backward direction is always somewhat less than in the direction of the α particle. Such a result receives a simple explanation if we suppose that the hydrogen nuclei are not built into the main nucleus but exist as satellites probably in motion round a central core. There can be no doubt that bombardment by α particles has effected a veritable disintegration of the nuclei of this group of elements. It is significant that the liberation of hydrogen nuclei only occurs in elements of odd atomic number, viz. 5, 7, 9, 11, 13, 15, the elements of even number appearing quite unaffected. For a collision of an α particle to be effective, it must either pass close to the nucleus or actually penetrate its structure. The chance of this is excessively small on account of the minute size of the nucleus. For example, although each individual α particle will pass through the outer structure of more than 100,000 atoms of aluminium in its path, it is only about one α particle in a million that gets close enough to the nucleus to effect the liberation of its hydrogen satellite.

This artificial disintegration of elements by α particles takes place only on a minute scale, and its observation has only been possible by the counting of individual swift hydrogen nuclei by the scintillations they produce in zinc sulphide.

These experiments suggest that the hydrogen nucleus or proton must be one of the fundamental units which build up a nucleus, and it seems highly probable that the helium nucleus is a secondary building unit composed of the very close union of four protons

and two electrons. The view that the nuclei of all atoms are ultimately built up of protons of mass nearly one and of electrons has been strongly supported and extended by the study of *isotopes*. It was early observed that some of the radioactive elements which showed distinct radioactive properties were chemically so alike that it was impossible to effect their separation when mixed together. Similar elements of this kind were called "isotopes" by Soddy, since they appeared to occupy the same place in the periodic table. For example, a number of radioactive elements in the uranium and thorium series have been found to have physical and chemical properties identical with those of ordinary lead, but yet to have atomic weights differing from ordinary lead, and also distinctive radioactive properties. The nuclear theory of the atom offers at once a simple interpretation of the relation between isotopic elements. Since the chemical properties of an element are controlled by its nuclear charge and little influenced by its mass, isotopes must correspond to atoms with the same nuclear charge but of different nuclear mass. Such a view also offers a simple explanation why the radioactive isotopes show different radioactive properties, for it is to be anticipated that the stability of a nucleus will be much influenced by its mass and arrangement.

Our knowledge of isotopes has been widely extended in the last few years by Aston, who has devised an accurate direct method for showing the presence of isotopes in the ordinary elements. He has found that some of the elements are "pure"—*i.e.,* consist of atoms of identical mass—while others contain a mixture of two or more isotopes. In the case of the isotopic elements, the atomic mass, as ordinarily measured by the chemist, is a mean value depending on the atomic masses of the individual isotopes and their relative abundance. These investigations have not only shown clearly that the number of distinct species of atoms is much greater than was supposed, but have brought out a relation between the elements of great interest and importance. The atomic masses of the isotopes of most of the elements examined have been found, to an accuracy of about one in a thousand, to be whole numbers in terms of oxygen, 16. This indicates that the nuclei are ultimately built up of protons of mass very nearly one and of electrons. It is natural to suppose that this building unit is the hydrogen nucleus, but that its average mass in the complex nucleus is somewhat less than its mass in the free state owing to the close packing of the charged units in the nuclear structure. We have already seen that the helium nucleus of mass 4 is probably a secondary unit of great importance in the building up of many atoms, and it may be that other simple combinations of protons and electrons of mass 2 and 3 occur in the nucleus, but these have not been observed in the free state.

While the mass of the majority of the isotopes are nearly whole numbers, certain cases have been observed by Aston where this rule is slightly departed from. Such variations in mass may ultimately prove of great importance in throwing light on the arrangement and closeness of packing of the protons and electrons, and for this reason it is to be hoped that it may soon prove possible to compare atomic masses of the elements with much greater precision even than at present.

While we may be confident that the proton and the electron are the ultimate units which take part in the building up of all nuclei, and can deduce with some certainty the number of protons and electrons in the nuclei of all atoms, we have little, if any, information on the distribution of these units in the atom or on the nature of the forces that hold them in equilibrium. While it is known that the law of the inverse square holds for the electrical forces some distance from the nucleus, it seems certain that this law breaks down inside the nucleus. A detailed study of the collisions between α particles and hydrogen atoms, where the nuclei approach very close to each other, shows that the forces between nuclei increase ultimately much more rapidly than is to be expected from the law of the inverse square, and it may be that new and unexpected forces may come into importance at the very small distances separating the protons and electrons in the nucleus. Until we gain more information on the nature and law of variation of the forces inside the nucleus, further progress on the detailed structure of the nucleus may be difficult. At the same time, there are still a number of hopeful directions in which an attack may be made on this most difficult of problems. A detailed study of the γ rays from radioactive bodies may be expected to yield information as to the motion of the electrons inside the nucleus, and it may be, as Ellis has suggested, that quantum laws are operative inside as well as outside the nucleus. From a study of the relative proportions of the elements in the earth's crust, Harkins has shown that elements of even atomic number are much more abundant than elements of odd number, suggesting a marked difference of stability in these two classes of elements. It seems probable that any process of stellar evolution must be intimately connected with the building up of complex nuclei from simpler ones, and its study may thus be expected to throw much light on the evolution of the elements.

The nucleus of a heavy atom is undoubtedly a very complicated system, and in a sense a world of its own, little, if at all, influenced by the ordinary physical and chemical agencies at our command. When we consider the mass of a nucleus compared with its

volume it seems certain that its density is many billions of times that of our heaviest element. Yet, if we could form a magnified picture of the nucleus, we should expect that it would show a discontinuous structure, occupied but not filled by the minute building units, the protons and electrons, in ceaseless rapid motion controlled by their mutual forces.

Before leaving this subject it is desirable to say a few words on the important question of the energy relations involved in the formation and disintegration of atomic nuclei, first opened up by the study of radioactivity. For example, it is well known that the total evolution of energy during the complete disintegration of one gramme of radium is many millions of times greater than in the complete combustion of an equal weight of coal. It is known that this energy is initially mostly emitted in the kinetic form of swift α and β particles, and the energy of motion of these bodies is ultimately converted into heat when they are stopped by matter. Since it is believed that the radioactive elements were analogous in structure to the ordinary inactive elements the idea naturally arose that the atoms of all the elements contained a similar concentration of energy, which would be available for use if only some simple method could be discovered of promoting and controlling their disintegration. This possibility of obtaining new and cheap sources of energy for practical purposes was naturally an alluring prospect to the lay and scientific man alike. It is quite true that, if we were able to hasten the radioactive processes in uranium and thorium so that the whole cycle of their disintegration could be confined to a few days instead of being spread over thousands of millions of years, these elements would provide very convenient sources of energy on a sufficient scale to be of considerable practical importance. Unfortunately, although many experiments have been tried, there is no evidence that the rate of disintegration of these elements can be altered in the slightest degree by the most powerful laboratory agencies. With increase in our knowledge of atomic structure there has been a gradual change of our point of view on this important question, and there is by no means the same certainty to-day as a decade ago that the atoms of an element contain hidden stores of energy. It may be worth while to spend a few minutes in discussing the reason for this change in outlook. This can best be illustrated by considering an interesting analogy between the transformation of a radioactive nucleus and the changes in the electron arrangement of an ordinary atom. It is now well known that it is possible by means of electron bombardment or by appropriate radiation to excite an atom in such a way that one of its superficial electrons is displaced from its ordinary stable position to another temporarily stable position further removed from the nucleus. This electron in course of time falls back into its old position, and its potential energy is converted into radiation in the process. There is some reason for believing that the electron has a definite average life in the displaced position, and that the chance of its return to its original position is governed by the laws of probability. In some respects an "excited" atom of this kind is thus analogous to a radioactive atom, but of course the energy released in the disintegration of a nucleus is of an entirely different order of magnitude from the energy released by return of the electron in the excited atom. It may be that the elements, uranium and thorium, represent the sole survivals in the earth to-day of types of elements that were common in the long distant ages, when the atoms now composing the earth were in course of formation. A fraction of the atoms of uranium and thorium formed at that time has survived over the long interval on account of their very slow rate of transformation. It is thus possible to regard these atoms as having not yet completed the cycle of changes which the ordinary atoms have long since passed through, and that the atoms are still in the "excited" state where the nuclear units have not yet arranged themselves in positions of ultimate equilibrium, but still have a surplus of energy which can only be released in the form of the characteristic radiation from active matter. On such a view, the presence of a store of energy ready for release is not a property of all atoms, but only of a special class of atoms like the radioactive atoms which have not yet reached the final state for equilibrium.

It may be urged that the artificial disintegration of certain elements by bombardment with swift α particles gives definite evidence of a store of energy in some of the ordinary elements, for it is known that a few of the hydrogen nuclei, released from aluminium for example, are expelled with such swiftness that the particle has a greater individual energy than the α particle which causes their liberation. Unfortunately, it is very difficult to give a definite answer on this point until we know more of the details of this disintegration.

On the other hand, another method of attack on this question has become important during the last few years, based on the comparison of the relative masses of the elements. This new point of view can best be illustrated by a comparison of the atomic masses of hydrogen and helium. As we have seen, it seems very probable that helium is not an ultimate unit in the structure of nuclei, but is a very close combination of four hydrogen nuclei and two electrons. The mass of the helium nucleus, 4.00 in terms of $O=16$, is considerably less than the mass 4.03 of four hydrogen nuclei. On modern views there is believed to be a very close connection between mass and energy, and

this loss in mass in the synthesis of the helium nucleus from hydrogen nuclei indicates that a large amount of energy in the form of radiation has been released in the building of the helium nucleus from its components. It is easy to calculate from this loss of mass that the energy set free in forming one gramme of helium is large even compared with that liberated in the total disintegration of one gramme of radium. For example, calculation shows that the energy released in the formation of one pound of helium gas is equivalent to the energy emitted in the complete combustion of about eight thousand tons of pure carbon. It has been suggested by Eddington and Perrin that it is mainly to this source of energy that we must look to maintain the heat emission of the sun and hot stars over long periods of time. Calculations of the loss of heat from the sun show that this synthesis of helium need only take place slowly in order to maintain the present rate of radiation for periods of the order of one thousand million years. It must be acknowledged that these arguments are somewhat speculative in character, for no certain experimental evidence has yet been obtained that helium can be formed from hydrogen.

The evidence of the slow rate of stellar evolution, however, certainly indicates that the synthesis of helium, and perhaps other elements of higher atomic weight, may take place slowly in the interior of hot stars. While in the electric discharge through hydrogen at low pressure we can easily reproduce the conditions of the interior of the hottest star as far as regards the energy of motion of the electrons and hydrogen nuclei, we can not hope to reproduce that enormous density of radiation which must exist in the interior of a giant star. For this and other reasons it may be very difficult, or even impossible, to produce helium from hydrogen under laboratory conditions.

If this view of the great heat emission in the formation of helium be correct, it is clear that the helium nucleus is the most stable of all nuclei, for an amount of energy corresponding to three or four α particles would be required to disrupt it into its components. In addition, since the mass of the proton in nuclei is nearly 1.000 instead of its mass 1.0072 in the free state, it follows that much more energy must be put into the atom than will be liberated by its disintegration into its ultimate units. At the same time, if we consider an atom of oxygen, which may be supposed to be built up of four helium nuclei as secondary units, the change of mass, if any, in its synthesis from already formed helium nuclei is so small that we can not yet be certain whether there will be a gain or loss of energy by its disintegration into helium nuclei, but in any case we are certain that the magnitude of the energy will be much less than for the synthesis of helium from hydrogen. Our information on this subject of energy changes in the formation or disintegration of atoms in general is as yet too uncertain and speculative to give any decided opinion on future possibilities in this direction, but I have endeavored to outline some of the main arguments which should be taken into account.

I must now bring to an end my survey, I am afriad all too brief and inadequate, of this great period of advance in physical science. In the short time at my disposal it has been impossible for me, even if I had the knowledge, to refer to the great advances made during the period under consideration in all branches of pure and applied science. I am well aware that in some departments the progress made may justly compare with that of my own subject. In these great additions to our knowledge of the structure of matter every civilized nation has taken an active part, but we may be justly proud that this country has made many fundamental contributions. With this country I must properly include our Dominions overseas, for they have not been behindhand in their contributions to this new knowledge. It is, I am sure, a matter of pride to this country that the scientific men of our Dominions have been responsible for some of the most fundamental discoveries of this epoch, particularly in radioactivity.

This tide of advance was continuous from 1896, but there was an inevitable slackening during the War. It is a matter of good omen that, in the last few years, the old rate of progress has not only been maintained but even intensified, and there appears to be no obvious sign that this period of great advances has come to an end. There has never been a time when the enthusiasm of the scientific workers was greater, or when there was a more hopeful feeling that great advances were imminent. This feeling is no doubt in part due to the great improvement during this epoch of the technical methods of attack, for problems that at one time seemed unattackable are now seen to be likely to fall before the new methods. In the main, the epoch under consideration has been an age of experiment, where the experimenter has been the pioneer in the attack on new problems. At the same time, it has been also an age of bold ideas in theory, as the Quantum Theory and the Theory of Relativity so well illustrate.

I feel it is a great privilege to have witnessed this period, which may almost be termed the Renaissance of Physics. It has been of extraordinary intellectual interest to watch the gradual unfolding of new ideas and the ever-changing methods of attack on difficult problems. It has been of great interest, too, to note the comparative simplicity of the ideas that have ultimately emerged. For example, no one could have anticipated that the general relation between the ele-

ments would prove to be of so simple a character as we now believe it to be. It is an illustration of the fact that Nature appears to work in a simple way, and that the more fundamental the problem often simpler are the conceptions needed for its explanation. The rapidity and certitude of the advance in this epoch have largely depended on the fact that it has been possible to devise experiments so that few variables were involved. For example, the study of the structure of the atom has been much facilitated by the possibility of examining the effects due to a single atom of matter, or, as in radioactivity or x-rays, of studying processes going on in the individual atom which were quite uninfluenced by external conditions.

In watching the rapidity of this tide of advance in physics I have become more and more impressed by the power of the scientific method of extending our knowledge of Nature. Experiment, directed by the disciplined imagination either of an individual, or still better, of a group of individuals of varied mental outlook, is able to achieve results which far transcend the imagination alone of the greatest natural philosopher. Experiment without imagination, or imagination without recourse to experiment, can accomplish little, but, for effective progress, a happy blend of these two powers is necessary. The unknown appears as a dense mist before the eyes of men. In penetrating this obscurity we can not invoke the aid of supermen, but must depend on the combined efforts of a number of adequately trained ordinary men of scientific imagination. Each in his own special field of inquiry is enabled by the scientific method to penetrate a short distance, and his work reacts upon and influences the whole body of other workers. From time to time there arises an illuminating conception, based on accumulated knowledge, which lights up a large region and shows the connection between these individual efforts, so that a general advance follows. The attack begins anew on a wider front, and often with improved technical weapons. The conception which led to this advance often appears simple and obvious when once it has been put forward. This is a common experience, and the scientific man often feels a sense of disappointment that he himself had not foreseen a development which ultimately seems so clear and inevitable.

The intellectual interest due to the rapid growth of science to-day can not fail to act as a stimulus to young men to join in scientific investigation. In every branch of science there are numerous problems of fundamental interest and importance which await solution. We may confidently predict an accelerated rate of progress of scientific discovery, beneficial to mankind certainly in a material but possibly even more so in an intellectual sense. In order to obtain the best results certain conditions must, however, be fulfilled. It is necessary that our universities and other specific institutions should be liberally supported, so as not only to be in a position to train adequately young investigators of promise, but also to serve themselves as active centers of research. At the same time there must be a reasonable competence for those who have shown a capacity for original investigation. Not least, peace throughout the civilized world is as important for rapid scientific development as for general commercial prosperity. Indeed, science is truly international, and for progress in many directions the co-operation of nations is as essential as the cooperation of individuals. Science, no less than industry, desires a stability not yet achieved in world conditions.

There is an error far too prevalent to-day that science progresses by the demolition of former well-established theories. Such is very rarely the case. For example, it is often stated that Einstein's general theory of relativity has overthrown the work of Newton on gravitation. No statement could be farther from the truth. Their works, in fact, are hardly comparable, for they deal with different fields of thought. So far as the work of Einstein is relevant to that of Newton, it is simply a generalization and broadening of its basis; in fact, a typical case of mathematical and physical development. In general, a great principle is not discarded but so modified that it rests on a broader and more stable basis.

It is clear that the splendid period of scientific activity which we have reviewed to-night owes much of its success and intellectual appeal to the labors of those great men in the past, who wisely laid the sure foundations on which the scientific worker builds today, or to quote from the words inscribed in the dome of the National Gallery, "The works of those who have stood the test of ages have a claim to that respect and veneration to which no modern can pretend."

ERNEST RUTHERFORD

SCIENTIFIC EVENTS

THE GORGAS MEMORIAL INSTITUTE OF TROPICAL AND PREVENTIVE MEDICINE[1]

1. The Gorgas Memorial was organized under the laws of the state of Delaware with Admiral Braisted, Honorable John Bassett Moore, Surgeon General Ireland, Surgeon General Stitt, Surgeon General Cumming, Dr. Leo S. Rowe, Honorable Jose E. Lefevre of the Panaman Legation, President Belisario Porras of Panama, and Dr. Franklin Martin as the sponsors.

2. The object of the organization is to raise money,

[1] Statement presented to the American Medical Association by Dr. Franklin H. Martin.

the interest of which will sustain a working memorial to General Gorgas, whose genius stamped out yellow fever and malaria in Cuba and Panama, and who taught us how to control those diseases.

3. The memorial is to be known as the Gorgas Memorial Institute of Tropical and Preventive Medicine, and will take the form of a research laboratory and a teaching institute in Panama for those branches of medicine.

4. The headquarters of this institute will be presided over by a board of scientific directors, of which Professor Richard P. Strong, of Harvard University, has been selected as the first director. The institute will be located in Panama on a beautiful site on the shore of the Pacific, which was formerly in the exposition grounds of the city of Panama. The site was donated by the Republic of Panama, and President Porras, backed by the citizens of Panama, has guaranteed the initial buildings.

5. It is the plan of the directors of the institute to raise the sum of five million dollars, which will be invested in trust securities, and only the interest of which is to be used to carry on the purposes of the organization.

6. The board of directors is composed of the following named men:

Honorary president, president of the United States.
Dr. Belisario Porras, president, Republic of Panama.
Surgeon General Merritte W. Ireland, United States Army, Washington.
Surgeon General Hugh S. Cumming, United States Public Health Service.
Dr. Seale Harris, president of the Southern Medical Association.
Mr. Bernard Baruch, New York.
Mr. W. P. C. Harding, president of the Federal Reserve Bank, Boston.
Mr. Fred W. Upham, president, Consumers' Company, Chicago.
Dr. W. H. G. Logan, professor of oral surgery, Chicago College of Dental Surgery.
Dr. Gilbert Fitz-Patrick, chairman of the board of control, American Institute of Homeopathy, Chicago.
Dr. Leo S. Rowe, director-general, Pan American Union, Washington.
Surgeon General Edgar R. Stitt, United States Navy, Washington.
Brig. Gen. Robert E. Noble, Surgeon General's Library, Washington.
Hon. R. J. Alfard, Panaman minister, Washington, D. C.
Judge John Bassett Moore, Court of International Justice, The Hague.
Mr. Samuel Gompers, president of the American Federation of Labor.
Brig. Gen. Charles G. Dawes, president of the Central Trust Company of Illinois.
Mr. Adolph Ochs, editor, New York *Times*, New York.
Dr. Frank Billings, Chicago.
Vice-president and chairman of Board of Directors, Dr. Franklin H. Martin, director-general, American College of Surgeons.

THE ROOSEVELT WILD LIFE FOREST EXPERIMENT STATION

THE Roosevelt Wild Life Forest Experiment Station, Syracuse, N. Y., recently received a valuable gift in the form of an exhibit showing in 14 stages the preparation of Hudson seal or seal-dyed muskrat from the raw skin to the fully dyed fur. This exhibit is enclosed in a polished mahogany case, 20 feet long, with plate glass front, and with electrical illumination. The whole exhibit is beautifully executed. This gift was made by A. Hollander & Son, of Newark, N. J., the leading dyers of this fur, and through the friendly services of Mr. Max Herskovitz, of Alfred Herskovitz and Son, New York City.

Mr. Edward R. Warren, fur naturalist of the station, is continuing his investigations of the beaver in the Yellowstone National Park, begun in 1921. He is aided by Mr. James E. Mills, a volunteer assistant. These studies have been made possible by the gift of the services of these men and by funds from members of the Board of Trade of the Fur Industry of New York City. The cooperation on the part of these men of the fur industry is a part of their program to encourage research and conservation of fur-bearing animals, as they realize that the permanence of the industry depends upon a sustained yield of raw fur.

Mr. Aretas A. Saunders, field ornithologist, has devoted the summer to a study of the breeding grounds of ducks in western New York. His report on the birds of the Alleghany State Park has just been published in the *Roosevelt Wild Life Bulletin*.

Dr. Charles E. Johnson, formerly fur naturalist of the station, who made a study of the Adirondack beaver for the station in 1921, has devoted the summer to a study of the status of muskrat in western New York. Dr. Johnson, recently of the University of Kansas, has accepted a professorship in the department of forest zoology in the New York State College of Forestry.

Dr. William C. Kendall, ichthyologist, assisted by W. A. Dence and W. P. Osborn, continued his investigation of the trout of the Cranberry Lake region in the western Adirondacks which is being made in cooperation with Commissioner Alexander Macdonald, of the N. Y. State Conservation Commission. These are the finest trout waters in the Adirondacks.

CHAS. C. ADAMS
Director

THE WORLD'S DAIRY CONGRESS

THE opening sessions of the congress will be held on October 2 and 3 at Washington, when the discus-

sions will be of broad international character. The first day will be devoted largely to the official welcome of delegates. It is expected that President Coolidge will welcome to America the representatives of the 37 governments which are sending delegates in response to the invitation of our State Department. In the event of his absence, Charles E. Hughes, secretary of state, will speak. It is planned to have the address of welcome responded to by J. Maenhaut, of Brussels, Belgium, president of the International Dairy Federation. Other speakers scheduled for the Washington sessions include: H. E. Van Norman, president of the World's Dairy Congress Association; Herbert Hoover, secretary of commerce; F. O. Lowden, ex-governor of Illinois, and president of the Holstein-Friesian Association of America; Charles Porcher, editor of *Le Lait*, of Lyon, France; L. G. Michaels, representing the International Institute of Agriculture, Rome, Italy; J. A. Ruddick, Dairy and Cold Storage Commissioner, Agricultural Department of Canada; Henry C. Wallace, secretary of agriculture for the United States, and J. D. Miller, president of the National Federation of Milk Producers and vice-president and general counsel of the Dairymen's League, Inc., Utica, New York.

The congress delegates will spend October 4 at Philadelphia as guests of the National Dairy Council. After their welcome by Mayor J. H. Moore, they will spend the day in observing the methods employed by the council in promoting a wiser use of milk. At the session, Dr. Clyde L. King, secretary of the Commonwealth of Pennsylvania, who has for several years arbitrated milk disputes at Philadelphia and at Baltimore, Md., will preside, and the speakers will include M. D. Munn, president of the National Dairy Council. Gifford Pinchot, governor of Pennsylvania, will address the delegates at a banquet in the evening.

The delegates will hold their meeting from October 5 to 10 in cooperation with the seventeenth annual National Dairy Exposition at Syracuse, New York. There, several sessions will be held simultaneously each morning and visitors may choose those dealing with the topics of particular interest to them. The topics, from day to day, will be as follows:

October 5—(1) Evaporated, condensed and dried milk in the dietary; (2) business organization; (3) cheese production; (4) extension methods in dairy education; (5) dairy publications.

October 6—(1) The nutritional value of milk; (2) ice cream problems; (3) improving and protecting the milk supply; (4) methods of dairy instruction; (5) dairy publications.

October 8—(1) Educating the public in the value of milk; (2) cooperative milk marketing; (3) control of quality in manufactured products; (4) transportation and bulk handling; (5) milk in the diet.

October 9—(1) City milk problems; (2) cooperative marketing of manufactured products; (3) butter manufacture; (4) milk secretion and the nutrition of dairy cows; (5) chemistry and bacteriology of milk.

October 10—(1) Equipment, construction and standardization; (2) condensed milk and milk products; (3) the control of the quality of milk; (4) breeding; (5) diseases of dairy cattle.

Among the prominent speakers will be:

A. Peter, director of the Government Dairy School, at Rutti, Zollikofen, professor of dairying in the Federal Technical High School, at Zurich, Switzerland; Dr. Constantino Gorini, professor of bacteriology and hygiene, Agricultural High School, Milan, and at the University of Pavia, Italy; Dr. R. H. Leitch, professor of dairying and chief of the dairy research department, West of Scotland Agricultural College; J. H. Blackshaw, O.B.E., dairy commissioner, Ministry of Agriculture and Fisheries, England; Dr. A. J. Swaving, inspector of dairying, Department of Agriculture, Holland; Dr. L. B. Mendel, physiological chemist of Yale University and editor of *The Journal of Biological Chemistry;* Dr. H. C. Sherman, professor of food chemistry, Columbia University; Dr. E. V. McCollum, professor of chemical hygiene, Johns Hopkins University; Dr. Willibald Winkler, professor of dairying industry and bacteriology, Hochschule fuer Bodenkulture, Vienna; Miss Helen G. Campbell, of the Dairy and Cold Storage Commission, Department of Agriculture, Canada; Dr. C. Orla-Jensen, professor in veterinary sciences and bacteriology, Royal Agricultural and Veterinary College of Denmark; Dr. Haakon Isaachsen, professor of animal nutrition, Royal Agricultural College of Norway; Dr. Osakar Laxa, professor and director, Bacteriological Institute, Slovak Polytechnic School, Prague; Professor A. Miyawaki, of the Hokkaido Imperial University, Sapporo; J. H. Maggs, chairman of the directors, United Dairies, Ltd., London; J. L. Kraft, the American cheese distributor; E. C. Sutton, the American ice cream manufacturer; John Drysdale, of the Scottish Agricultural Society; J. Hill, manager of the Belfast (Ireland) Cooperative Society.

THE ECLIPSED ECLIPSE

DR. E. E. SLOSSON, Science Service, reports from San Diego: Although the eclipse was eclipsed by clouds, a lot has been learned about how to take it. I have just seen something that has never been seen before—motion pictures of a solar eclipse. These are still in the negative stage and on account of low visibility do not amount to much as movies, but they demonstrate that the new methods of aerial observation employed by the aircraft squadron at San Diego under the command of Captain A. W. Marshall will be a valuable aid to both astronomy and meteorology. No wonder the telescope on Point Loma could not penetrate the clouds, for three successive veils interposed between them and the sun: First, stratus clouds from 500 feet to 4,000; next a fairly clear stretch up to 17,000, where the fliers entered dense alto-cumulus,

through breaks in which they could see the lighter cirrus floating at 30,000. Lieutenant B. H. Wyatt, who planned the observations, took his post in the comparatively clear layer at 13,000 feet, facing the shadow of the moon advancing from the north. To the right of its edge he saw a sharp red line extending along the horizon and a halo around the sun fifteen diameters away from it. During totality the recording thermometer at this altitude showed a rise of three and a half degrees Fahrenheit instead of the anticipated drop period. The humidity fell from sixty-three to fifty-two per cent. On the northeast quadrant of the sun a red plume projected more than half the sun's diameter. Lieutenant Wyatt was able to warn the astronomers three days in advance that September 10 would probably be cloudy, for he finds that when the upper air is fifteen degrees warmer than below, the coast of Southern California is in for fog. Ordinarily there is a fall of three degrees for each thousand feet ascended, but this is reversed when the hot air currents rising from the deserts of southeast California and Arizona moving seaward over-run the cold damp air from the ocean. Lieutenant Wyatt explained his theory of long range forecasting at the Los Angeles meeting of the American Association for the Advancement of Science.

FELLOWSHIPS IN COAL MINING PROBLEMS

The six college graduates who have been appointed to the annual research fellowships at the Carnegie Institute of Technology in Pittsburgh have already begun their studies of a wide variety of coal-mining problems. A significant feature of the research program for the year of 1923–1924 lies in the fact that two of the fellowships were newly established in order to carry on studies specifically requested by two private firms in the coal industry, both companies having agreed to finance the research work.

Each of the research fellows will work during the current year under the supervision of an official attached to the Pittsburgh Station of the Bureau of Mines. In accordance with the policy of the past two years, the results of the studies will be published at the end of the year by the Advisory Board of coal operators and engineers in cooperation with the Cooperative Department of Mining Engineering at Carnegie Tech. The assignment of problems has been made as follows:

"The relation of acidity and oxygen to corrosion of metals and alloys in acid mine waters," Ralph E. Hall, physical chemist, U. S. Bureau of Mines, and Research Fellow W. W. Teague, University of Alabama.

"A study of efficiency in blasting coal," J. E. Tiffany, explosives testing engineer, U. S. Bureau of Mines, and Research Fellow C. W. Nelson, Carnegie Institute of Technology. (Requested and financed by the Hillman Coal and Coke Company.)

"A study of the practicability of gas masks and protection afforded by them in mine atmospheres which contain carbon monoxide, irritating vapors and smokes, and which support combustion in a flame safety lamp," G. S. McCaa, mine safety engineer, and S. H. Katz, associate physical chemist, U. S. Bureau of Mines, and Research Fellow A. L. Barth, Pennsylvania State College. (Requested and financed by the Mine Safety Appliances Company.)

"Correlation of coal beds in the Allegheny Formation of Western Pennsylvania and Eastern Ohio," Reinhardt Thiessen, research chemist, U. S. Bureau of Mines, and Research Fellow F. D. Wilson, University of Oregon.

"Effect of wheel diameter and other variables in friction losses in mine-car running-gear," Mayo D. Hersey, physicist, U. S. Bureau of Mines, and Research Fellow Howard E. Wetzel, Pennsylvania State College.

"The time-rate of combustion of coal-dust particles of definite sizes," C. M. Bouton, associate research chemist, U. S. Bureau of Mines, and Research Fellow J. M. Pratt, Swarthmore College.

THE AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS

At the first meeting of the board of directors of the American Institute of Electrical Engineers for the administrative year beginning August 1, held in New York on August 2, President Ryan announced the following appointments as chairmen of committees:

Standing Committees

Board of Examiners—H. H. Norris, New York.
Code of Principles of Professional Conduct—John W. Lieb, New York.
Coordination of Institute Activities—W. I. Slichter, New York.
Edison Medal—Edward D. Adams, New York.
Executive—Harris J. Ryan, Stanford University, Cal.
Finance—G. L. Knight, Brooklyn, N. Y.
Headquarters—E. B. Craft, New York.
Law—H. H. Barnes, Jr., New York.
Meetings and Papers—L. W. W. Morrow, New York.
Membership—M. E. Skinner, Pittsburgh.
Publication—Donald McNicol, New York.
Public Policy—H. W. Buck, New York.
Research—J. B. Whitehead, Baltimore.
Safety Codes—H. B. Gear, Chicago.
Sections—A. W. Berresford, Milwaukee.
Student Branches—C. E. Magnusson, Seattle.
Standards—H. S. Osborne, New York.

Technical Committees

Educational—W. E. Wickenden, New York.
Electrical Machinery—H. M. Hobart, Schenectady, N. Y.
Electrochemistry and Electrometallurgy—J. L. Yardley, Pittsburgh.
Electrophysics—F. W. Peek, Jr., Pittsfield, Mass.
Industrial and Domestic Power—H. D. James, Pittsburgh.

Instruments and Measurements—G. A. Sawin, Pittsburgh.

Iron and Steel Industry—F. B. Crosby, Worcester, Mass.

Lighting and Illumination—G. H. Stickney, Harrison, N. J.

Marine—G. A. Pierce, Jr., Philadelphia.

Mines—F. L. Stone, Schenectady, N. Y.

Power Stations—Nicholas Stahl, Providence.

Protective Devices—H. R. Woodrow, Brooklyn, N. Y.

Telegraphy and Telephony—O. B. Blackwell, New York.

Transmission and Distribution—F. G. Baum, San Francisco.

In accordance with the by-laws of the Edison medal committee, the board of directors confirmed the appointment by President Ryan of new members of this committee for terms of five years each as follows: C. C. Chesney, Pittsfield, Mass.; Robert A. Millikan, Pasadena, Cal., and M. I. Pupin, New York. The board also elected three of its members as members of the Edison medal committee for terms of two years each, namely, H. M. Hobart, Schenectady, N. Y.; Frank B. Jewett, New York, and W. K. Vanderpoel, Newark, N. J.

SCIENTIFIC NOTES AND NEWS

At the annual meeting of the American Chemical Society at Milwaukee on September 12, the Priestley Medal, awarded triannually by the society for distinguished services to chemistry, was bestowed on Dr. Ira Remsen, president and professor emeritus of Johns Hopkins University, Baltimore, at ceremonies at Marquette University.

The medal of the Institute of Radio Engineers has been awarded to John S. Stone, electrical engineer of the American Telephone and Telegraph Company at San Diego, for his research work in radio communication. The presentation of the medal took place at a dinner in his honor in San Francisco on August 31.

At a recent election, the Royal Academy of Medicine appointed as a foreign correspondent F. C. Waite, professor of histology and embryology in the Western Reserve University of Cleveland, Ohio.

Dr. R. Dohrn has been appointed administrative director of the Zoological Station at Naples.

On account of his change of residence, Dr. Sam F. Trelease has resigned his position as assistant secretary of the American Association for the Advancement of Science, and Dr. Charles A. Shull, associate professor of plant physiology in the University of Chicago, has been appointed assistant secretary of the association until the Christmas holidays. Dr. Trelease, for several years instructor in plant physiology at the Johns Hopkins University, has become professor of botany in the University of Louisville. Dr. Charles A. Shull is engaged in research in the laboratory of plant physiology of the Johns Hopkins University, where he will remain until the Christmas holidays.

Among Americans and Canadians attending the meeting of the British Association at Liverpool are Professors Lee and Pupin, of Columbia University; Professors Bancroft and Merritt, of Cornell University; Professor Lewis, of the University of California; Professor Noyes, of the University of Illinois, and Professors Adams, Eve, McCallum, Tate and Whitby, of McGill University.

The council of the American Mathematical Society plan to raise an endowment fund of at least one hundred thousand dollars and a committee on endowment has been appointed, consisting of Julian L. Coolidge, Harvard University (chairman); Arnold Dresden, University of Wisconsin; Griffith C. Evans, Rice Institute; Robert Henderson, Equitable Life Assurance Society, and George E. Roosevelt, 30 Pine Street, New York (treasurer).

Dr. E. B. Saye, formerly associate professor of pathology and bacteriology in the School of Medicine of Emory University, has resigned to accept the position of pathologist and bacteriologist at the State Insane Asylum at Milledgeville, Ga., and Dr. R. Henry Baldwin, formerly assistant professor of physiology, is now a member of the staff of St. Louis Hospital.

Dr. G. C. Southworth, who has been an instructor of physics at Yale University for the last five years, has accepted a position with the American Telephone and Telegraph Company, New York City.

Dr. A. Lustig, senator and professor of general pathology at Florence, has been invited to inaugurate the new quarters of the Biological Institute at Buenos Aires and the Italian Hospital.

Dr. Marion Hines, of the department of anatomy of the University of Chicago, has been granted a year's leave of absence, beginning in September, which she will spend in research work in the laboratories of Professor J. T. Wilson, of the University of Cambridge, and Elliot Smith, of the University of London.

Word has been received that Dr. D. H. Tennent, of Bryn Mawr College, who, with his family, went to Japan about six months ago to make a study of fishes, is safe in Shanghai, where he was staying at the time of the earthquake.

Charles M. Hoy, engaged in collecting mammals

in the interior of China for the U. S. National Museum, died there of appendicitis on September 8, according to cable advices to the Smithsonian Institution from Kuling, Kiangsi Province.

At the St. Louis meeting of the American Medical Association in 1922, the Section on Diseases of Children authorized the creation of the Abraham Jacobi Memorial Fund Committee, for the establishment of a permanent fund for the section. We learn from the *Journal* of the American Medical Association that a copy of the yearly transactions of the section is sent free to each contributor; a part or all of the expenses of a foreign guest of the section will be met by appropriations from the fund; pediatric exhibits in the Scientific Assembly of the American Medical Association will be encouraged, and, if advisable, the expense thereof paid from this fund, and wherever possible a grant will be made for the assistance of pediatric research or for charity. A new member of the committee is elected by the section each year to serve five years. The committee elects one of its members as secretary of the fund, and the oldest member in point of service on the committee acts as chairman. The following are the officers of the committee: Chairman, Dr. Laurence R. Debuys, New Orleans; secretary, Dr. Frank C. Neff, Kansas City, Mo., and members, Drs. Fritz B. Talbot, Boston; Clifford G. Grulee, Chicago, and Harold K. Faber, San Francisco.

The University of Indiana has received a check for $1,500 from the Home Insurance Company because cloudy weather prevented its expedition from taking photographs of the scientific value of the eclipse of the sun which would have been visible except for the clouds in Lower California on September 10. Swarthmore College also insured its expedition to obtain photographs against cloudy weather through the same company, taking a policy for $10,000. The University of Indiana paid a premium of $150. Swarthmore paid $500 for a *pro rata* policy and will be paid according to the degree of the failure to obtain satisfactory plates. Swarthmore's plates have not yet been developed.

A dispatch from Tokyo states that the loss to Japanese science by the fire and earthquake is enormous. The Imperial University's collection of scientific instruments was destroyed by the fire. It will take years to replace them.

The Chemical Exposition this year was held this week immediately following the annual meeting of the American Chemical Society. The usual meeting of the American Ceramic Society was held in conjunction with the exposition in the Grand Central Palace beginning on September 19. The annual banquet and election of the Salesmen's Association of the American Chemical Industry was also held during the week of the exposition. The regular dinner during the Chemical Exposition of the American Institute of Chemical Engineers was held Wednesday evening.

How radio is finding a use for many of the rare metals was shown at the composite radio exhibit at the National Exposition of Chemical Industries, which opened at the Grand Central Palace, New York, on September 17. A number of well-known firms contributed products of their manufacture which deal directly or indirectly with the construction or operation of radio instruments. Thorium, tellurium, selenium, tantalum, molybdenum—all metals rarely getting into commerce on a broad scale—were demonstrated. In addition to the metals, carborundum crystals, synthetic resins, hard-rubber radio parts, extremely fine precision instruments for electrical work and a number of other important features of the radio construction were demonstrated. Alundum tubes for use in measuring high temperatures, particularly in furnaces for drawing tungsten tube wire, formed part of the exhibit.

The Eighth Meeting of the Optical Society of America will be held at Cleveland, Ohio, Thursday, Friday and Saturday, October 25, 26 and 27. The hotel headquarters will be Hotel Cleveland and the meeting place for the program of papers will be Case School of Applied Science. Professor A. A. Michelson will read, by invitation, a paper on "The limit of accuracy in optical measurement," and there will be a program of contributed papers and committee reports. Arrangements are being made for visits to the Nela Research Laboratories, the National Lamp Works, Warner and Swasey and the Cleveland Museum of Art. The advance programs will be mailed to all members about October 5 or 10. Since there are other large conventions in Cleveland at the same time, hotels are likely to be crowded, and members are advised to make their hotel reservations at once. Dr. W. E. Forsythe, Nela Research Laboratory, Nela Park, Cleveland, is chairman of the local committee on arrangements and Dr. Irwin G. Priest, care of the Bureau of Standards, Washington, D. C., is the secretary of the society.

UNIVERSITY AND EDUCATIONAL NOTES

Dr. James S. Swartz, formerly treasurer of the International Mercantile Marine, chairman and for nearly forty years trustee of Bucknell University, has given to the university a 600-acre tract of land situated along the Potomac River valued conservatively at $60,000.

SEVERAL cousins of Austin B. Fletcher, who died on July 5 leaving the bulk of his fortune to Tufts College, have formally protested probate of his will by filing objections in the Surrogates' Court. The value of the estate is said to exceed $4,000,000.

Z. P. METCALF, professor of zoology and entomology in the North Carolina State College and entomologist of the North Carolina Experiment Station, has been appointed director of resident teaching in the College of Agriculture.

PROFESSOR J. W. MILLER, who has served as head of the department of electrical engineering of the Oklahoma Agricultural and Mechanical College for several years, has been appointed mechanical and electrical research engineer at the engineering experiment station of the University of Arkansas. Mr. Miller will devote his time exclusively to research work on problems of interest to the industries of the state.

MISS CLEMENTINA S. SPENCER, professor of zoology and for seven years acting head of the department in Coe College, Cedar Rapids, Iowa, has resigned and was recently married to Mr. Chester A. Momyer, of Chicago. The new head of the department, occupying the newly created Bert. H. Bailey chair of zoology, is Dr. T. H. Bissonnette, formerly of Queen's College, Ontario, and of the University of Chicago.

DR. GEORGE D. PORTER, Toronto, has been appointed head physical director at the University of Toronto, succeeding Dr. James W. Barton, who resigned last spring.

MR. ALAN G. OGILVIE has been appointed lecturer in geography in the University of Edinburgh in succession to Mr. G. G. Chisholm, who had held that position since the lectureship was founded in 1908.

WE learn from *Nature* that Dr. W. Schumann, director of the Institute of Technical Physics at Jena University, has been appointed professor of theoretical electrotechnics at the Munich Technical College; Dr. Julius Schmidt, of the Stuttgart Technical College, to be reader in chemistry at the Engineering College, Esslingen; and Dr. K. Fajans, to be assistant professor of physical chemistry at the University of Munich.

DISCUSSION AND CORRESPONDENCE

CONCERNING TUNNIES AND ALBACORES

THE huge fishes of the open seas, known as tunny, tuna and albacore, are well represented in the Mediterranean, in the West Indies and especially in the Pacific Ocean, about Southern California, Hawaii and Japan. On account of their great size, the species are rare in collections, and in no case have the forms in any one of these regions been adequately compared with those of any other.

The first thorough and by far the most important study of this group has been lately published by Dr. Kamakichi Kishinouye of the Imperial University of Tokyo.[1] Of late years, deep sea fishing has brought these fishes in great numbers to the Japanese markets, a fact which has given Dr. Kishinouye a most valuable opportunity.

In the study of the muscular layers and associated organs he finds characters of great value. Other important distinctive traits occur in the skeleton. Any treatment of the scombroid or mackerel-like fishes either systematically or anatomically must make constant use of this paper.

Dr. Kishinouye very properly restricts the *Scombridae* to the two very distinct genera, *Scomber* (in Japanese *Saba*) with the short spinous dorsal and *Rastrelliger*. The Spanish mackerel and its allies (in Japanese, *Sawara*) form the well-marked family of *Cybiidae*, visibly separated by the strong dentition, the many-spined dorsal-fin and the long parallel interhemal bones. To this group most of the known fossil mackerels belong.

The Tunnies differ from these ancestral types in so many ways that Kishinouye would make of them a distinct order, *Plecostei*, with two families, *Thunnidae* and *Katsuwonidae*, the first containing the *tunnies* and *albacores* (in Japanese, *Maguro* and *Shibi*), the latter their smaller allies (*Katsuwo*) with the peculiar trellis-like structure of the posterior hemal bones. The new name, *Katsuwonus*, is given to the section of the older genus *Euthynnus*, to which the oceanic bonito, *Euthynnus pelamis*, belongs. Two other new generic names, *Parathunnus* (*mebachi*), and *Neothunnus* (*macropterus*), apparently justified, occur in this paper, but its larger worth consists in its minute description of the structure, habits and values of each of more than a dozen Japanese species and in the finely accurate engravings by which the work is illustrated.

DAVID STARR JORDAN

STANFORD UNIVERSITY

PHOSPHATE BEHAVIOR IN SOILS

RESULTS obtained by extraction of soils with varied quantities of water and data obtained from displaced solutions are corroborative of the idea that phosphate in the effective solution of the soil constitutes a saturated solution. Two corollaries flow from this propo-

[1] Contributions to the Comparative Study of the so-called Scombroid Fishes, Kamakichi Kishinouye: *Journal of the College of Agriculture, Imperial University of Tokyo.*

sition: First, that different soils will have different phosphate ion concentrations, depending in each instance on the concentration of their other solutes and the reaction of their solutions. Second, that the phosphate concentration of the solution in a given soil will fluctuate also in accord with the concentration of other solutes and changes in reaction.

Any diminution of the concentration of solutes in the soil solution which reduces the active mass of cations tending to form relatively insoluble phosphates or which diminishes the buffer effect of the solution should tend to increase the phosphate concentration. The measurement of this effect has heretofore been impossible because no method has been available for the precise measurement of concentrations in the soil solution. The writers, following the suggestion of Parker, have recently shown[1] that solutions displaced from tightly compacted soils have uniform concentrations in their successive increments up to the time the displacing agent (water) begins to appear and that the total concentrations of electrolytes in such displaced solutions are inversely proportional to the total initial moisture contents of the soil. Such solutions apparently represent very closely, if indeed they do not constitute, the soil solution. Using such a procedure, we have demonstrated (unpublished data) that after a volume of solution equal to the amount of water initially contained in the compacted soil has been removed, the solutions obtained from a second displacement of the same mass of soil with an equal amount of water have decreasing total concentrations of electrolytes, but that the phosphate concentrations increase. This effect has doubtless been obscured in leaching experiments, because the leached soils have not been sufficiently compacted to prevent the admixture of the soil solution with the water poured on the top of the soil mass.

The importance of the above stated fact is that at the approach of the end of the growing season, the generally recognized diminished total concentration in the soil solution may be, and probably is, accompanied by an enhanced, or tendency toward an enhanced, concentration of phosphate. We have observed what appears to be the result of this effect in two soils, cropped to barley, during the past season, when the solutions displaced at the end of the season had very much higher concentrations of phosphate and lower concentration of other electrolytes than did the solutions displaced at the beginning of the season. It is evident that this effect may be masked by experimental error in soils of low total concentration or by increased absorption on the part of the plant if the crop being grown on the soils under observation absorbs very large amounts of phosphate in the later stages of growth.

In the latter case, while the effect may not be measurable, its existence should contribute to a greater absorption of phosphate by the plant. This effect, if generally confirmed, should explain many of the anomalies of phosphate behavior in plant nutrition and obviate the necessity for assuming any special mechanism such as the excretion of plant acids to account for the relatively large phosphate absorption as compared with low phosphate concentration in the soil solution.

JOHN S. BURD
J. C. MARTIN
LABORATORY OF PLANT NUTRITION,
UNIVERSITY OF CALIFORNIA

[1] "Water Displacement of Soils and the Soil Solution," Burd, John S. and Martin, J. C. In the *Journal of Agricultural Science*, Vol. XIII, Part III, July 1923.

QUOTATIONS

CHEMISTS IN HIGH PLACES

IN Rochester they tell the story that the Research Laboratory of the Eastman Kodak Company was founded by Mr. Eastman after a visit to Germany, during which a prominent industrialist boasted of his own research staff and asked Mr. Eastman how many chemists he employed upon research.

C. E. K. Mees, who had been managing director of Wratten & Wainwright, of England, from 1906 to 1912, came to be director of the Research Laboratory in the latter year, and began to make his intimate acquaintance among American chemists at the meeting of the Eighth International Congress of Applied Chemistry. He has become prominent among American chemists, and notwithstanding his increasing duties with his company, has had time to contribute much to the success of the Rochester local section. We can commend such activity to the many other plant executives. The Superintendents' Club at Kodak Park can offer many an interesting story of the early experiences of Dr. Mees as one of their number.

Not long since there were added to the duties of directing research those incident to development, which carries with it the responsibility of investigating and advising new departures in manufacture, based either upon the company's own discoveries or suggestions from others. We are pleased to say that Dr. Mees has since been made a director of the Eastman Kodak Company, the election taking place at a recent meeting of the directors. This promotion is pleasing personally, and is of interest to all chemists, proving as it does that a man properly qualified and trained, and with a willingness really to work may succeed in reaching the highest places in a corporation

by the chemical route. Having made a specialty of photographic theory and having a keen appreciation of scientific work both fundamental and applied, we venture the prediction that no director of the company will contribute more to the success of the corporation than Dr. Mees.

The election of chemists to high places in industrial organizations should not be so infrequent as to need editorial comment. The valuable qualities which the Eastman Kodak Company has discovered in Dr. Mees may be found by other commercial organizations among their own scientific staff. We venture to suggest that such an inquiry would reveal many men qualified to take such increased responsibility in the management of the company's affairs. Such a man will, of course, have native ability, made more valuable by the special training which a thorough grounding in chemistry and allied subjects is sure to give. With a little encouragement he will be able to pass sound judgment in differentiating between essentials and non-essentials in business, just as he must do in the course of his chemical work.—*Journal of Industrial and Engineering Chemistry.*

COMMITTEE ON LUMINESCENCE

The Committee on Luminescence of the National Research Council met at Ithaca, N. Y., on August 17th. Present were Messrs. C. D. Child, H. L. Howes, H. E. Ives, E. L. Nichols and Miss Frances G. Wick.

Mr. Child reported on the present status of our knowledge of the luminescence of mercury vapor and suggested that special attention be called to the following phenomena of mercury vapor which deserve further investigation: (1) The continuous spectrum which may be obtained under certain conditions of pressure and temperature, (2) the abnormal broadening of the absorption spectrum which occurs with increasing pressure of the vapor, (3) the fact that the luminosity of the continuous spectrum does not commence at the instant the vapor is excited and that it continues for an appreciable time after the excitation has ceased, (4) the increase in chemical activity occurring under the same conditions as those required for the continuous spectrum, and (5) the apparent decrease in the ionization potential occurring under the same conditions. The following explanations which have been suggested should be tested further: (1) That newly vaporized vapor is more active in giving the continuous spectrum than other vapor, and (2) that molecules are formed from excited atoms, that is, from atoms in which an electron has been removed to an outer orbit.

Mr. Howes gave a résumé of investigations of the luminescence of the rare earths and in particular of the extended researches of Urbain in this field.

Mr. Ives reported on the relations between the photo-electric effect and luminescence so far as the same have already been developed and urged that observers in these fields should keep in mind the importance of more definitely determining the nature of such interdependences as may exist.

Mr. Nichols discussed the structure of luminescence spectra. He announced that measurements made under his direction, and soon to be published, indicate that the apparently continuous luminescence spectra of solid solutions in general are made up of submerged, over-lapping bands having a constant frequency interval and that this interval is characteristic of the activating element; also that the spectrum of incandescent oxides, of flames containing burning metals such as magnesium, calcium, aluminum, etc., and probably of all incandescent solids, have the structure above described.

Miss Wick described studies of the luminescence spectra of certain natural fluorites previously heated to fusion. Instead of the relatively broad bands observed by Urbain and others in such fluorites, the modified spectrum consists of fine lines readily identified as those of samarium, europium, dysprosium, etc. The phosphorescence of these fluorites is greatly increased and prolonged by such heat treatment.

By invitation Messrs. D. T. Wilber and L. J. Boardman sat with the committee.

E. L. N.

SPECIAL ARTICLES

ULTRAMICROSCOPICALLY OBSERVABLE FLUORESCENCE

Since my last communication on the fluorescence of the blue-green algae, in which I expressed reserve regarding its visibility in chloroplasts, I have been able to demonstrate to others, observers of the highest competence, and thus to assure both them and myself that the chloroplasts of the leaves and of the green algae examined by me exhibit a marked degree of deep red fluorescence observable with the dark field condenser, when the optical conditions described (Science 58: 91–2. 3 Aug. 1923) are fulfilled. This observability gives new impulse to the study of the chloroplast.

Suspensions of living cells of a *Scenedesmus* and of a *Monostroma* are fluorescent to the eye when examined in a dark room in a narrow beam of strong light of w. l. approx. 530 and less, and their spectra in this light exhibit a strong band in the red, as K. Stern found for *Chlorella* (Ber bot. Ges. 38: 28. 1920). The same general statement may be made for suspensions of chloroplasts in water and in glycerine.

E. g. the filtrate from *Saponaria* leaves ground with water and sand behaved in this way. When observed ultramicroscopically, all these showed the deep red fluorescence.

J. Reinke (Bot. Zeit. 44: 166 ff. 1886) believed that rhodophyll is composed of two "atom groups," one similar to the green component of chlorophyll; the other, a water soluble substance set free on death and only then becoming fluorescent. It would be of interest to examine the Florideae for fluorescence by means of the dark field condenser. I hope that some one working with these forms in reach will find time and inclination to make the examination.

For bringing into view the fluorescence of chloroplasts the use of glycerine or cane sugar (or equivalent) is necessary. I may iterate that it is at the apex of the inverted cone of illumination, obtained by reflection from the cover glass, that fluorescence is observable. A thin (0.8 mm. or less) slide and a dry objective are required.

In the above media some chloroplasts maintain their fluorescence for a surprisingly long time, though in this they do not all behave alike. Those of *Chlorophytum* and of *Aspidistra* have remained fluorescent in concentrated cane sugar for over a month, the preparation lying on a table in diffused light. During that period, those mounted in glycerine have nearly all lost their fluorescence—a few only are still so at the present writing. In water the chloroplasts, as is well known, rapidly break down or become vacuolated, as they do, but more slowly, in weak glycerine, according to the amount of water present. Under these circumstances no fluorescence is observable, ultramicroscopically, though it may not be absent.

In the chloroplasts of *Vaucheria* the fluorescent pigment soon becomes segregated into one to several vacuoles which are individually fluorescent, and which suffer more or less extrusion. There is a presumption that these vacuoles are identical with the drops of "assimilatory substance" observed by A. Meyer (Ber. bot. Ges. 36: 674. 1918) and by G. Mangenot (C. R. soc. biol. 83: 892. 1920).

With regard to the *Cyanophyceae,* I now find that, irrespective of the genus, the species may be divided into two groups, distinguishable by their fluorescent colors, those which are red (but with difference of shade corresponding it may be with various forms of phycocyanin) and those which are orange. These two groups will probably be found to align themselves with those found by K. Boresch, using spectrum analysis, to contain on the one hand a blue pigment with carmine red fluorescence, and, on the other, a red pigment having an orange-yellow fluorescence, separable from each other also by capillary analysis (Biochem. Z. 119:167. 1921).

The importance of an adequate evaluation of the behavior of the fluorescent pigments is indicated by the recent important work of B. Moore, E. Whitley and T. A. Webster (36 Ann. Rep. Oceanog. Dept. L'pool. 1922) who advance evidence to show that the role of the red pigment in the Florideae is not simply that of a screen, but that it is actively catalytic, partaking in photosynthesis.

FRANCIS E. LLOYD

MCGILL UNIVERSITY

NEW HAMPSHIRE ACADEMY OF SCIENCE

THE New Hampshire Academy of Science held its fourth annual meeting at Alton Bay and at Durham, New Hampshire, May 25, 26 and 27. The academy is bringing together men in scientific work in New Hampshire, including members of the staff of Dartmouth College and the University of New Hampshire, technicians from industrial organizations, teachers of science in secondary schools and some noteworthy amateurs.

A feature of the annual meeting is a field excursion. Last year this took the form of a trip afoot into King Ravine, of the White Mountain, a great glaciated area. This year a boat was chartered for a trip to points of interest in Lake Winnepesaukee.

The program of papers read was as follows:

A review of cellulose hydration theories as applied to beating: M. O. SCHUR.

Auxiliary problems in nitrogen fixation: GEORGE A. PERLEY.

Chlorination of state water supplies: C. L. POOL.

The Schick test for diphtheria: K. C. ATKINS.

The feeble-minded mother in New Hampshire: B. W. BAKER.

Some relations of metabolism to growth and reproduction in plants: H. R. KRAYBILL.

Lethal hereditary factors in butterflies: J. H. GEROULD.

Determination of stellar distances: J. M. POOR.

What of science? L. B. RICHARDSON.

Wild life in New Brunswick: LELAND GRIGGS.

The human side of science: EDWIN E. SLOSSON.

Symposium on "Curriculum of the high and the junior high schools of New Hampshire":

Some theoretical considerations or the what and why: J. W. TWENTE.

Economy in the social orientation of children: E. W. BUTTERFIELD.

The new alchemy: GORDON L. CAVE.

The social science core in secondary education—a study in curriculum making: A. N. FRENCH.

Place of home economics in high school training: HELEN F. MCLAUGHLIN.

W. C. O'KANE,
Secretary

SCIENCE NEWS

RADIO AIDS TO NAVIGATION ON THE PACIFIC COAST

Science Service

THE Pacific coast is deficient in radio aids to navigation, officials of both the Navy Department and the Lighthouse Service agreed when questioned concerning possible causes for the recent wreck of seven U. S. destroyers and the Pacific Mail S. S. *Cuba* near Point Arguello, California.

Investigation has brought out the fact that neither radio beacons nor radio compass stations have been installed anywhere on the long stretch of dangerous coast between San Francisco and Pt. Arguello, along which the destroyers were traveling. There is a radio compass at Pt. Arguello lighthouse and another farther down the coast at Pt. Hueneme, but bearings from two stations are needed to give a navigator his position and only the first named station was available to those on the wrecked ships.

There are two types of radio aids to navigators, the radio compass, operated by the Navy Department, and the radio beacon, operated by the Lighthouse Service. The radio compass stations are equipped to give the commander of a vessel at sea his compass bearing from the station in question. If such bearings from two stations can be obtained the position of the vessel may be accurately ascertained. The bearing is worked out by the land operator.

The radio beacon operates on a different principle. Radio signals are sent out broadcast in all directions at frequent intervals. Vessels are equipped with radio "direction finders" which enable them to locate the bearing of the sending station. If the bearings of two stations can be had the ship's position can be worked out.

Each system has its advocates. The Navy Department favors the radio compass because it asserts that it is more accurate for the determination of bearings to be made by experts ashore who do nothing else, than by radio officers on shipboard who have many other distracting duties. Lighthouse officials favor the radio beacon with the direction finder on the ship, as they assert it is best to have the responsibility for the ship's position fixed on board the vessel and not by some one ashore. The direction finder for use in connection with radio beacons has already been adopted by many of the large transatlantic and eastern passenger lines, and by the Standard Oil Company for the equipment of its tank steamers.

Only two radio beacons are at present in operation on the Pacific Coast. These are on lightships off San Francisco and off the mouth of the Columbia River. Radio compass stations are more frequent but there are none between San Francisco and Pt. Arguello.

Little credence is given by government experts to the theory that the wrecks may have been caused by a current set up by an earthquake under the sea, or by the remoter ones in Japan. Such a thing is considered possible but unlikely. All unite, however, in the need of better radio protection to shipping along the western coast.

EARTHQUAKE-PROOF HOUSES

Science Service

MAN, and not nature, is to blame for the disastrous consequences of earthquakes in such localities as Japan, Chile or California, in the opinion of Dr. Bailey Willis, one of America's leading geologists, who has just returned from Chile where he traced the earthquake of last November to its lair high in the Andes.

Referring to his investigations in Chile as a representative of the Carnegie Institution of Washington, Dr. Willis said to *Science Service*: "When it came to the point of a verdict which should place the chief responsibility for the disaster upon the right shoulders, we could not convict the earthquakes. Where Nature gives warning after warning, but man remains heedless, he has but himself to blame for the consequences. So it was in Chile, so it is in Japan, and so it will be in California or wherever else earthquake risk is carelessly disregarded."

Dr. Willis is professor emeritus of geology at Stanford University and he declared that he is a good Californian except that he is inclined to take earthquakes seriously. Dr. Willis explains how earthquake-proof houses may be built and he also relates his experiences in addressing the population of the town of Vallenar in Chile, badly damaged by last year's earthquake. He said: The mayor of Vallenar invited me to meet a group of gentlemen in the Union Club to talk to them about earthquakes. The president of the local workingmen's union desired a more public discussion and the mayor yielded the point. The meeting was held in a temporary theater with a capacity for about 400 people and it was crowded. In front sat a group of officials, the priest, and the landowners. To the number of fifty they represented that portion of the audience which could read, write and cipher. The workmen were there in force, few of them wearing anything more than shirt and trousers. There were many women, their dark faces stamped with resignation and half hidden in the black mantillas. Young girls, youths and street urchins were scattered among their elders and some of the last looked down from perches in the rafters I have spoken to many audiences, but not to any that was more responsive or attentive. This was for them no academic discussion. The earthquake had been a terrible experience and before them was a man who was supposed to know how to guard against a repetition of disaster in Vallenar, or whether they must abandon their city and move to another site, as was proposed.

No one of any feeling could look into those dark, sad faces and not realize how urgent is the solution of the

SCIENCE

VOL. LVIII SEPTEMBER 28, 1923 No. 1500

CONTENTS

SCIENCE: A Weekly Journal devoted to the Advancement of Science, edited by J. McKeen Cattell and published every Friday by

THE SCIENCE PRESS

Lancaster, Pa. Garrison, N. Y.

New York City: Grand Central Terminal.

Annual Subscription, $6.00. Single Copies, 15 Cts.

SCIENCE is the official organ of the American Association for the Advancement of Science. Information regarding membership in the association may be secured from the office of the permanent secretary, in the Smithsonian Institution Building, Washington, D. C.

Entered as second-class matter July 18, 1923, at the Post Office at Lancaster, Pa., under the Act of March 3, 1879.

MODERN ZOOLOGY[1]

ZOOLOGY has far outgrown its early boundaries when it could be defined simply as a part of natural history, and at no period has its growth been more rapid or more productive in results of scientific and practical importance than in the interval since our last meeting in this city. It is, however, impossible, even if time permitted, for any one observer to survey the many lines of activity in zoology or to record its contributions to knowledge in this fruitful period. I have thought it might be profitable to endeavor to take in retrospective glance the broad outlines of development of zoology during the last two or three decades, and then to limit our further consideration more especially to some of the relations of zoology to human welfare. The period under review has witnessed a growth of our knowledge of the living organism of the same order of importance as the progress in our knowledge of the atom. Never have investigators probed so deeply or with so much insight into the fundamental problems of the living animal; the means for observation and recording have become more delicate, and technique of all kinds more perfect, so that we can perceive details of structure and follow manifestations of activity of the organism which escaped our predecessors.

At the time of the last Liverpool meeting and for some few years previously, a distrust of the morphological method as applied to the study of evolution had been expressed by a number of zoologists. At that meeting Professor MacBride put forward an able defense of morphology while recognizing that the morphological method had its limitations, which must be observed if the conclusions are to rest on safe ground. Through undue zeal of some of its devotees morphology had been pushed too far on arid and unproductive lines, and rash speculation based on unsound morphology brought discredit on this branch of our science. It is now fully recognized that the observed resemblances between animals are due, some of them to genetic relationships, and others to convergent evolution, and therefore that the conclusions drawn from the study of morphology are to be interpreted with the greatest circumspection. There are some groups of animals, *e.g.*, the earthworms, in regard to the evolutionary history of which we can

[1] From the address of the president of the Section of Zoology of the British Association for the Advancement of Science, Liverpool, September, 1923.

never hope to receive help from paleontology; we must perforce make the best use we can of the morphological method applied, be it understood, with wide knowledge and deep insight. That careful systematic work, coupled with the skilful application of sound morphological principles, is capable of yielding results of specific and general importance is well illustrated by the researches of Michaelsen and of Stephenson on Indian Oligochetes; these authors have been able to trace the lines of evolution of the members of the family Megascolecidae so completely that we know their history as well as we know that of the Equidae. Again, to take an example from a different category, the fine morphological work on the cell and on the nucleus and its chromosomes which we owe to Hertwig, Flemming, Boveri, van Beneden, Wilson and others, made possible the modern researches and conceptions in regard to inheritance and sex. The danger that morphology will be pushed to excess is long past; the peril seems to me to be rather in the opposite direction, *i.e.*, that some of our students before passing on to research receive too little of that training and discipline in exact morphology by which alone they can be brought to appreciate how the components of the living organism are related to one another and to those of allied species or genera, and how they afford, with proper handling, many data for the evolutionist. I plead, therefore, for the retention of a sound and adequate basis of morphology in our zoological courses.

No one who engages in the study of morphological problems can proceed far without meeting questions which stimulate inquiry of a physiological nature, and, where means are available, resort to experimental procedure is the natural mode of arriving at the answer. That morphology is detrimental to or excludes experimental or physiological methods is entirely contrary to present day experience, and indeed the fruitfulness of the combination of morphology and physiology could have been amply illustrated any time during the last eighty years simply by reference to the work of Johannes Müller. The structure of an organism must be known before its coordinated movements can be adequately appreciated—morphology must be the forerunner of physiology.

Another of the basal supports of our science an appreciation of which, or better still a training in some branch of which, we must encourage is the systematic or taxonomic aspect. The student or graduate who is proceeding to specialize in experimental zoology or in genetics particularly requires a sound appreciation of the fact that the accurate determination of the genus and species under investigation is a primary requisite for all critical work—it is part of the fundamental data of the experiment and is essential, if for nothing else, to permit subsequent observers to repeat and perhaps to extend any given series of observations. Moreover, the systematic position of an animal is an expression of the final summary of its morphology and its genetic relationships, and it is from such summaries that we have to attempt in many cases—as, for example, in the Oligochetes already cited—to discover in a restricted group or order the probable course of evolution, though the method of evolution may not be ascertainable. From these summaries prepared by systematists issue problems for the experimental evolutionist and the geneticist. As Mr. Bateson has pointed out, it is from the systematist who has never lost the longing for the truth about evolution that the raw materials for genetical researches are to be drawn, and the separation of the laboratory men from the systematists imperils the work and the outlook of both.

Among the notable features of zoological activity during the last twenty-five years the amount of work on the physiology of organisms other than mammals must attract early notice in any general survey of the period. Eighty years ago Johannes Müller's physiological work was largely from the comparative standpoint, but for some years after his death the comparative method fell into disuse, and the science of physiology was concerned chiefly with the mode of action of the organs of man or of animals closely related to man, the results of which have been of outstanding importance from their bearing on medicine. Interest in the more general applications of physiology was revived by Claude Bernard ("Leçons sur les phénomènes de la vie," 1878), and the appearance of Max Verworn's "General Physiology," in 1894, was in no inconsiderable measure responsible for the rapid extension of physiological methods of inquiry to the lower organisms—a development which has led to advances of fundamental importance. Many marine and freshwater organisms lend themselves more readily than the higher vertebrates to experimentation on the effects of alterations in the surrounding medium, on changes in metabolic activity, on the problems of fertilization and early development, on the chemistry of growth and decline, and to the direct observation of the functioning of the individual organs and of the effects thereon of different kinds of stimuli. The study of these phenomena has greatly modified our interpretation of the responses of animals and has given a new impetus to the investigation of the biology and habits of animals, *i.e.*, animal behavior. This line of work—represented in the past by notable contributions such as those by Darwin on earthworms, and by Lubbock on ants, bees and wasps—has assumed during the last two or three decades a more intensive form, and has afforded a more adequate idea of the living organism as a working entity, and revealed the delicacy of balance which exists between structure,

activity and environment. This closer correlation of form, function and reaction is of the greatest value to the teacher of zoology, enabling him to emphasize in his teaching that for the adequate appreciation of animal structure a clear insight into the activities of the organism as a living thing is essential.

The penetrating light of modern investigation is being directed into the organism from its earliest stage. During the summer of 1897 Morgan discovered that the eggs of sea-urchins when placed in a two per cent. solution of sodium chloride in sea-water and then transferred to ordinary sea-water would undergo cleavage and give rise to larvae, and J. Loeb's investigations in this field are familiar to all students of zoology. Artificial parthenogenesis is not restricted to the eggs of invertebrates, for Loeb and others have shown that the eggs of frogs may be made to develop by pricking them with a needle, and from such eggs frogs have been reared until they were fourteen months old. The application of the methods of micro-dissection to the eggs of sea-urchins is leading to a fuller knowledge of the constitution of the egg, of the method of penetration of the sperm, and of the nuclear and cytoplasmic phenomena accompanying maturation and fertilization, and will no doubt be pursued with the object of arriving at a still closer analysis of the details of fertilization.

The desire for more minute examination of developing embryos led to the more careful study of the egg-cleavage, so that in cases suitable for this method of investigation each blastomere and its products were followed throughout development, and thus the individual share of the blastomere in the cellular genesis of the various parts of the body was traced. This method had been introduced by Whitman in his thesis on Clepsine (1878), but it was not until after the classical papers of Boveri on Ascaris (1892) and E. B. Wilson on Nereis (1892) that it came into extensive use. About the time of our last meeting here, and for the next twelve or fifteen years, elaborate studies on cell-lineage formed a feature of zoological literature and afforded precise evidence on the mode of origin of the organs and tissues, especially of worms, molluscs and ascidians. A further result of the intensive study of egg-cleavage has been to bring into prominence the distinction between soma-cells and germ-cells, which in some animals is recognizable at a very early stage, *e.g.*, in Miastor at the eight-cell stage. The evidence from this and other animals exhibiting early segregation of germ-cells supports the view that there is a germ-path and a continuity of germ-cells, but the advocates of this view are constrained to admit there are many cases in which up to the present an indication of the early differentiation of the germ-cells has not been forthcoming on investigation, and that the principle can not be held to be generally established.

A cognate line of progress which, during the period under review, has issued from the intensive study of the egg and its development is experimental embryology—devoted to the experimental investigation of the physical and chemical conditions which underlie the transformation of the egg into embryo and adult. By altering first one and then another condition our knowledge of development has been greatly extended, by artificial separation of the blastomeres the power of adjustment and regulation during development has been investigated, and by further exploration of the nature of the egg the presence of substances foreshadowing the relative proportions and positions of future organs has been revealed in certain cases, the most striking of which is the egg of the Ascidian *Cynthia partita* (Conklin, 1905). Still further intensive study of the cytoplasm and nuclei of eggs and cleavage stages is required to throw light on the many problems which remain unsolved in this domain.

Progress in investigation of the egg has been paralleled by increase in our knowledge of the germ-cells, especially during their maturation into eggs and sperms, the utmost refinements of technique and observation having been brought to bear on these and on other cells. During the last thirty years, and especially during the latter half of this period, cytology has developed so rapidly that it has become one of the most important branches of modern biology. One of the landmarks in its progress was the appearance, at the end of 1896, of E. B. Wilson's book on "The Cell," and we look forward with great expectations to the new edition which, it is understood, is in an advanced stage of preparation. A great stimulus to cytological work resulted from the rediscovery in 1900 of the principle of heredity published by Mendel in 1865, which showed that a relatively simple conception was sufficient to explain the method of inheritance in the examples chosen for his experiments, for in 1902 Sutton pointed out that an application of the facts then known as to the behavior of the chromosomes would provide an explanation of the observed facts of Mendelian inheritance. In the same year McClung suggested that the accessory chromosome in the male germ-cells is a sex-determinant. These two papers may be taken as the starting point of that vast series of researches which have gone far toward the elucidation of two of the great problems of biology—the structural basis of heredity and the nuclear mechanism correlated with sex. The evidence put forward by Morgan and his colleagues, resulting from their work on Drosophila, would seem to permit little possibility of doubt that factors or genes are carried in the chromosomes of the gametes, and that the behavior of the chromosomes during maturation of the germ-cells and in fertilization offers a valid explanation of the mode of inheritance of characters. The solution of this great riddle of biology has been

arrived at through persistent observation and experiment and by critical analysis of the results from the point of view of the morphologist, the systematist, the cytologist, and the geneticist.

Among other important developments in the period reference may be made to the great activity in investigation of the finer structure of the nerve-cell and its processes. By 1891 the general anatomical relations of nerve-cells and nerve-fibers had been cleared up largely through the brilliant work of Golgi and Cajal on the brain and spinal cord, and of von Lenhossék, Retzius, and others on the nervous system of annelids and other invertebrates. In these latter had been recognized the receptor cells, the motor or effector cells, and intermediary or internunciary cells interpolated between the receptors and effectors. In June, 1891, Waldeyer put forward the neurone theory, the essence of which is that the nerve-cells are independent and that the processes of one cell, though coming into contiguous relation and interlacing with those of another cell, do not pass over into continuity. He founded his views partly upon evidence from embryological researches by His,but chiefly on results obtained from Golgi preparations and from anatomical investigations by Cajal. The neurone theory aroused sharp controversy, and this stimulus turned many acute observers—zoologists and histologists—to the intimate study of the nerve-cell. First among the able opponents of the theory was Apáthy, whose well-known paper, published in 1897, on the conducting element of the nervous system and its topographical relations to the cells, first made known to us the presence of the neurofibrillar network in the body of the nerve-cell and the neurofibrils in the cell-processes. Apáthy held that the neurofibrillar system formed a continuous network in the central nervous system, and he propounded a new theory of the constitution of the latter, and was supported in his opposition to the neurone theory by Bethe, Nissl and others. The controversy swung to and fro for some years, but the neurone theory—with certain modifications—seems now to have established itself as a working doctrine. The theory first enunciated as the result of morphological studies receives support from the experimental proof of a slight arrest of the nerve-impulse at the synapse between the two neurones, which causes a measurable delay in the transmission. The latest development in morphological work on nerve-elements is the investigation of the neuromotor system in the Protozoa. Sharp (1914), Yocom (1918), and Taylor (1920), working in Kofoid's laboratory, have examined this mechanism in the ciliates Diplodinium and Euplotes and they describe and figure a mass—the neuromotorium—from which fibrils pass to the motor organs, to the sensory lip, and, in Diplodinium, to a ring round the oesophagus. The function of the apparatus is apparently not supporting or contractile, but conducting. By the application of the finest methods of micro-dissection specimens of Euplotes have been operated upon while they were observed under an oil-immersion objective. Severance of the fibres destroyed coordination between the membranelles and the cirri, but other incisions of similar extent made without injuring the fibrillar apparatus did not impair coordination, and experiments on Paramaecium by Rees (1922) have yielded similar results. While the experimental evidence is as yet less conclusive than the morphological, it supports the latter in the view that the fibrils have a conducting, coordinating function. Progress in our knowledge of the nervous system is but one of many lines of advance in our understanding of the correlation and regulation of the component parts of the animal organism.

The ciliate protozoa have been the subject during the last twenty years of a series of investigations of great interest, conducted with the purpose of ascertaining whether decline and death depend on inherent factors or on external conditions. While these researches have been in progress we have come to realize more fully that ciliates are by no means simple cells, and that some of them are organisms of highly complex structure. Twenty years ago Calkins succeeded in maintaining a strain of Paramaecium for twenty-three months, during which there were 742 successive divisions or generations, but the strain, which had exhibited signs of depression at intervals of about three months, finally died out, apparently from exhaustion. From this work, and the previous work of Maupas and Hertwig, the opinion became general that ciliates are able to pass through only a limited number of divisions, after which the animals weaken, become abnormal and die, and it was believed that the only way by which death could be averted was by a process of mating or conjugation involving an interchange of nuclear material between the two conjugants and resulting in a complete reorganization of the nuclear apparatus. Jennings has shown that conjugation is not necessarily beneficial, that the ex-conjugants vary greatly in vitality and reproductive power, and that in most cases the division rate is less than before conjugation. Woodruff has since May 1, 1907, kept under constant conditions in culture a race of Paramaecium. During the sixteen years there have been some ten thousand generations, and there seems no likelihood of or reason for the death of the race so long as proper conditions are maintained. The possibility of conjugation has been precluded by isolation of the products of division in the main line of the culture, and the conclusion is justifiable that conjugation is not necessary for the continued life of the organism. The criticism that Woodruff's stock

might be a non-conjugating race was met by placing the Paramaecia, left over from the direct line of culture, under other conditions when conjugation was found to occur. Later observations by Erdmann and Woodruff show that a reorganization of the nuclear apparatus of Paramaecium takes place about every twenty-five to thirty days (forty to fifty generations). This process, termed endomixis (in contrast to amphimixis), seems to be a normal event in the several races of Paramaecium which Erdmann and Woodruff have examined, and it is proved to coincide with the low points or depressions in the rhythm exhibited by Paramaecium. The occurrence of endomixis raises the question, to which at present there is no answer, as to whether this process is necessary for the continued health of the nuclear apparatus and of the cytoplasm of Paramaecium.

Enriques (1916) maintained a ciliate—*Glaucoma pyriformis*—through 2,701 generations without conjugation, and almost certainly without endomixis. From a single "wild" specimen he raised a large number and found that conjugating pairs were abundant, so that the objection could not be made that this was a non-conjugating race. Enriques then began his culture with one individual, and examined the descendants morning and evening, removing each time a specimen for the succeeding culture. The number of divisions per day varied from nine to thirteen, and as there was no break in the regularity and rapidity of division, and no sort of depression, Enriques concluded that neither endomixis nor conjugation could have occurred, for these processes take some time and would have considerably reduced the rate of division. These results, especially if they are confirmed by cytological study of preserved examples, show that for Glaucoma neither conjugation nor endomixis is necessary for continued healthy existence. Hartmann's observations (1917) on the flagellate *Eudorina elegans* extend the conclusion to another class of Protozoa. He followed this flagellate through 550 generations in two and a half years. The mode of reproduction was purely asexual, and there was no depression and no nuclear reorganization other than that following fission. The evidence seems sufficient to confirm the view that certain Protozoa, if kept under favorable conditions, can maintain their vigor and divide indefinitely, without either amphimixis or endomixis.

Child (1915) states as the result of his experiments that the rate of metabolism is highest in Paramaecium and other ciliates immediately after fission—"in other words, after fission the animals are physiologically younger than before fission." This view, that rejuvenescence occurs with each fission, derives support from the observations of Enriques and Hartmann, for no other process was found to be taking place and yet the vigor of their organisms in culture was unimpaired. If, then, fission is sufficiently frequent—that is, if the conditions for growth remain favorable—the protoplasm maintains its vigor. If through changes in the external conditions the division rate falls, the rejuvenescence at each fission may not be sufficient to balance the deterioration taking place between the less frequent divisions. Under such conditions endomixis or conjugation may occur with beneficial results in some cases, but if these processes are precluded there is apparently nothing to arrest the progressive decline or "ageing" observed by Maupas and others. But further investigations are required on the physiology and morphology of decline in the protozoan individual.

The culture of tissues outside the body is throwing new light on the conditions requisite for the multiplication and differentiation of cells. R. G. Harrison (1907) was the first to devise a successful method by which the growth of somatic cells in culture could be followed under the microscope, and he was able to demonstrate the outgrowth of nerve-fibers from the central nervous tissue of the frog. Burrows (1911), after modifying the technique, cultivated nervous tissue, heart-cells, and mesenchymatous tissue of the chick in blood-plasma and embryonic extract, and this method has become a well-established means of investigation of cell-growth, tissues from the dog, cat, rat, guinea-pig, and man having been successfully grown. One strain of connective tissue-cells (fibroblasts) from the chick has been maintained in culture in vigorous condition for more than ten years, that is for probably some years longer than would have been the normal length of life of the cells in the fowl. Heart-cells may be grown generation after generation—all traces of the original fragment of tissue having disappeared —the cells forming a thin, rapidly growing, pulsating sheet. Drew (1922) has recently used instead of coagulated plasma a fluid medium containing calcium salts in a colloidal condition, and has obtained successful growth of various tissues from the mouse. He finds that epithelial cells when growing alone remain undifferentiated, but on the addition of connective tissue differentiation soon sets in, squamous epithelium producing keratin, mammary epithelium giving rise to acinous branching structures, and when heart-cells grow in proximity to connective tissue they exhibit typical myofibrillae, but if the heart-cells grow apart from the connective tissue they form spindle-shaped cells without myofibrillae. This study of the conditions which determine the growth and differentiation of cells is only at the beginning, but it is evident that a new line of investigation of great promise has been opened up which should lead also to a knowledge of the factors which determine slowing down of the division-rate and the cessation of division, and finally the complete decline of the cell.

For many lines of work in modern zoology bio-

chemical methods are obviously essential, and the applications of physics to biology are likewise highly important—*e.g.*, in studies of the form and development of organisms and of skeletal structures. Without entering into the vexed question as to whether all responses to stimuli are capable of explanation in terms of chemistry and physics, it is very evident that modern developments have led to the increasing application of chemical and physical methods to biological investigation, and consequently to a closer union between biology, chemistry and physics. It is clear also that the association of zoology with medicine is in more than one respect becoming progressively closer—comparative anatomy and embryology, cytology, neurology, genetics, entomology and parasitology, all have their bearing on human welfare.

J. H. Ashworth

BIOLOGICAL ABSTRACTS

On April 22, 1922, a meeting was held of representatives of 18 national biological organizations to consider the advisability of forming a federation,[1] and a year later, on April 26, 1923, the Union of American Biological Societies was formally inaugurated by the organization of a Council composed of accredited representatives of 15 member societies.

At the 1922 meeting, a publication committee of four was appointed to function jointly with a similar committee of the Division of Biology and Agriculture of the National Research Council. This committee presented a report to the Council of the Union at the latter's organization meeting, April 26, 1923. The report was adopted and the Council of the Union took the following actions:

(1) The Council of the Union of American Biological Societies considers that a single comprehensive system of biological abstracts is urgently needed.

(2) That the present Publications Committee be continued and given power to add to its membership subject to the approval of the Executive Committee of the Union of American Biological Societies and of the Executive Committee of the Division of Biology and Agriculture of the National Research Council.

(3) That the Council empower the Publications Committee (a) to formulate detailed plans for putting into effect a comprehensive system of biological abstracts for presentation to the Executive Committee of the Council of the Union and to the Executive Committee of the Division of Biology and Agriculture of the National Research Council; (b) to cooperate with the National Research Council in the continuation of its efforts to gain support for publication, abstracting and bibliography.

(4) That the Executive Committee of the Union be empowered to pass, jointly with the Executive Committee of the Division of Biology and Agriculture of the National Research Council, finally upon such plans presented by the Joint Publications Committee, it being understood that such plans do not involve other than voluntary financial commitments of societies or constituent members thereof.

(5) That the Publications Committee be authorized to determine the probable support from members of constituent societies for a comprehensive system of biological abstracts.

The substance of the Joint Publication Committee's report, with some additions, follows.

While the Joint Committee is one on publication and bibliography, the discussions which led up to its appointment centered about the need and desire for abstracting and indexing services. So, while recognizing the fundamental need for improved publication facilities, the committee has up to the present confined its attention largely to the problem of a comprehensive integrated system of biological abstracts.

It is considered unnecessary to present extended evidence of, or arguments for, the importance of adequate informational aids to the investigator and teacher. Very early, even when the output of scientific literature was an insignificant fraction of its present volume, the need for aids was felt, and bibliographies, either unclassified or classified only as to certain major subdivisions, were developed. As the situation grew more complex, more detailed aids were needed, and there evolved from the relatively simple bibliographies the more highly classified and indexed ones which have reached a high state of development, though in different ways, in such agencies as the Concilium Bibliographicum, International Catalogue of Scientific Literature, etc.

Then, in the second half, and especially in the closing quarter of the last century, with natural science largely emancipated from traditional restraints, scientific publication increased by leaps and bounds, and the impossibility of thorough search of the original sources, because of limited library facilities and insufficient time, necessitated still more detailed aids. So, especially in the last two or three decades of the last century, began the conspicuous development of abstracts. These abstracts furnished at the same time classified bibliographies and brief accounts of current work. But the modern, detailed, searching subject index was not at first a feature of the abstracting journal, at least not of the biological ones; this indexing represents a still later development. Literature aids have thus undergone an extensive evolution, and are destined to develop still further to meet future changing conditions and demands.

There has probably never before been a time when

[1] Science, 56, 184–185, 1922.

interest in making scientific information ascertainable has been so general throughout the rank and file of scientific workers. In the past, the problem has been mainly the business of a few—bibliographic experts or occasional men of science fired with the vision of the great service to be rendered to research and teaching by better mechanical aids in the literature. The man of science has, therefore, in a very large measure felt himself remote from such enterprises, which in consequence have not enjoyed his full support and active participation. Large numbers of scientific workers have thought of literature aids as necessary but hardly requiring their attention or participation. The dignity to which their importance entitles them has frequently not been accorded bibliographic efforts.

But the increasingly difficult problem faced by scientists due to the bewildering increase in the amount of literature has brought a gradual realization, earlier in some groups than in others, that the subject is of such vital importance that it demands their general support and participation. Only within the past few years has this sense of responsibility quickened generally among American biologists. This awakening is not entirely spontaneous. In large measure we have been aroused by the sudden collapse or serious impairment, during and since the war, of some of the most important of the aids on which we have relied in the past. This has helped us to realize how indispensable these are, and also that their production is a gigantic task requiring and deserving our best talent and efforts. It has awakened us, too, to the fact that, having so long accepted, without perhaps proper appreciation, the fruits of the efforts of our European colleagues, we can not now shirk those responsibilities which, because of our present more fortunate situation, are clearly ours. Whatever the contributing causes, it is a fact that these have led, within the past five years, to the establishment of four agencies in America which endeavor to abstract and index a large part of the world's literature in their respective fields—Endocrinology and Abstracts of Bacteriology in 1917, Botanical Abstracts in 1918, and the International Medical and Surgical Survey in 1919.

The committee has attempted to study the problem in a more or less fundamental way, giving especial attention to the organization, scope, completeness and adequacy of existing agencies, in order to discover if possible the shortcomings and causes thereof of the present procedure, and thereby be able, perhaps, to suggest ways and means of improvement.

A survey has been made by the Committee of the agencies which attempt to make a serious contribution to biological bibliography of international or national scope. (A brief résumé of this survey is appended to the minutes of the meeting of the Council of the Union of American Biological Societies held April 26, 1923.) This survey includes between 75 and 100 agencies devoted wholly or in considerable part to bibliography (abstracts, indexes, bibliographies, etc.) in the biological sciences, excluding psychology and anthropology. In this number are included many of those medical agencies in which the fundamental preclinical sciences as well as clinical medicine are extensively represented.

Of this large list, one has attempted to cover the whole of biology, indeed the whole of science. Several seek to cover botany and zoology, respectively, in a comprehensive way. Others have such large objectives as medicine and agriculture. But the great majority have a very restricted scope, so restricted as in many cases to deprive the user of adequate contact with important related fields of biology which contribute to his specialty.

In the judgment of the committee, a fundamental weakness in the present procedure is the multiplicity of uncorrelated and inadequately supported agencies. The majority of these reviewing, listing, indexing and abstracting organs more or less efficiently serve special interests, and till the part of the biological field selected more or less imperfectly and incompletely with the result that the abstracting, indexing and listing in these departments is diffusely distributed, incompletely done, and often treated from restricted points of view. Inevitable, too, under this procedure is an appalling amount of duplication.

The effect of this dispersive movement in the bibliographical and abstracting field as a whole in biology has some features of immediate service—condensation of references, esprit de corps within the subject and its immediate clientele, etc. Upon biology as a whole and upon synthesis, common progress, and upon a wider diffusion of interest in other fields than that of the biologist's immediate endeavor this segregation is less helpful to the progress of biology on sound and broad lines. It is believed that a complete, well-edited and well-organized system of biological abstracts would contribute fundamentally in the way of suggestion, stimulus and widening point of view and greater precision in attack upon our common problems. Such a system, too, would avoid the unnatural segregation of plant and animal material in such unified subjects as genetics, evolution and cytology, and the unfortunate separation of much plant and animal physiology, pathology, ecology, etc., which still occurs in many of our largest services, because confining their efforts to the plant or to the animal field.

But quite apart from these considerations this dispersive tendency involves serious practical difficulties. The narrower the scope of a service, the more limited its support. The literature in many if not

all special fields is so widely diffused in scientific publications that it becomes quite impossible for the relatively weak special services to approximate completeness or adequacy. The meager support which such agencies can command means, too, that they are carried on very largely by personal enthusiasm and sacrifice with the uncertainties and discontinuity which this procedure is likely to involve.

In striking contrast to this more or less chaotic situation in biology, the committee has been impressed with the well-ordered procedure in chemistry, which in comparison is so splendidly served in America by one strong, well-supported system of abstracting and indexing.

The type of bibliographic aid preferred varies with the character of the work and training and habits of the individual biologist. Classified indexed bibliographies in book or card form and abstracts in book form are the chief more highly developed types now in use. The systematist especially prefers a highly classified arrangement, which has been achieved both in indexed bibliographies (*e.g.*, Zoological Record (book form) and Concilium Bibliographicum (card form) and in abstracting journals (*e.g.*, Just's Botanischer Jahresbericht). But the committee is convinced from its inquiries that the type of service which most nearly meets the needs and desires of the great majority of workers is the abstracting journal with detailed carefully prepared indexes. It is believed that by adding to the monthly abstracting journal the feature of annually cumulated, classified, bound volumes the service in general would be improved and the needs of those especially requiring a detailed classified or indexed arrangement met. Such an arrangement, too, would more nearly meet the needs of libraries, which in general express a preference for classified or indexed bibliographies. Since limited support has so greatly handicapped bibliographic undertakings in biology it is felt that any new developments should be so conceived as to merit and command the widest possible support.

The success and efficiency which characterize the plan of the American chemists in making the subject of chemistry a unit for purposes of abstracting and indexing and the further important fact that this plan has the uniform automatic support of members of the American Chemical Society, has encouraged the committee to secure the facts necessary for an approximate picture of the proportions and feasibility of a similar plan for biological literature under the auspices of the Union of American Biological Societies.

The committee has attempted to ascertain the approximate volume of the world's biological literature as measured by the annual number of titles. Its studies in this direction lead to the conclusion that the annual number of titles approximates 40,000. These calculations include the literature in the biological sciences, including plant and animal industry and paleontology, but excluding clinical medicine and psychology.

To check the committee's estimates, Mr. Gunnell, of the United States Regional Bureau of the International Catalogue of Scientific Literature, was asked to tabulate the annual number of titles in the various parts of the International Catalogue of Scientific Literature concerned with the biological sciences. Mr. Gunnell's total for 1913, the last year for which all parts of the catalogue appeared unaffected by the war, is 37,779.

The number of pages required to cover this literature (40,000 titles) in one abstracting journal on the basis that 6.8 titles could be cared for per page (the approximate average in *Botanical Abstracts* and *Abstracts of Bacteriology*) is approximately six thousand.[3]

Cost of manufacture and distribution of twelve monthly numbers totalling 6,000 pages plus 500 pages of index (estimated) in an edition of 7,000 (the committee has secured bids from ten or twelve printing establishments, on one of which this estimate is based)	$52,144.00
Estimated annual income from 1,000 institutional subscriptions at $15.00	15,000.00
Balance of manufacturing and distributing cost to be met by individual support	$37,144.00
Probable cost of manufacture and distribution to the individual should each of the 6,000 individuals who are members of the societies invited to adhere to the Union support a unified system[4]	$ 6.20

[3] The question of bulk of such a service having been raised, the possibility has been considered of issuing it in parts individually obtainable. The committee is of the opinion that breaking up the publication would introduce complications and uncertainties which might involve an increase in the cost to the individual and a weakening of the undertaking, should it be entered upon. The policy of the American Chemists, now in successful operation for sixteen years, too, has impressed the committee with the desirability of keeping the service intact. The committee has, therefore, sought to meet the problem of size in another way, namely by searching for less bulky papers. Excellent papers are available which bulk less than one inch per thousand pages. Using such paper would reduce the linear shelf room, annually necessary for the volumes, to less than six inches, even should the journal report on approximately all the world's biological literature. For libraries and others desiring them, copies printed on heavier paper could be furnished.

[4] Since binding, probably in two volumes, would be necessary to make the journal thoroughly usable as a reference work, the subscriber would have an additional outlay of $4.00 or $5.00, or a total cost in the vicinity of $10.00 or $11.00.

Editorial overhead: These calculations do not include editorial, bibliographic and clerical overhead. The National Research Council is continuing its efforts to secure adequate support for international scientific bibliography and abstracting. If these efforts meet with further success such support may be expected, at least at the outset, largely to meet such overhead.

The above calculations are based on twelve monthly numbers annually, the abstracts classified in subject-matter sections with cross references, so that the material in a particular field can be consulted as conveniently as in a journal of more limited scope. In order, however, to provide a more highly classified instrument, especially for the systematist and others particularly served by such an arrangement, and also to bring all material for a given year and in a given category together, the committee has investigated the additional expense involved in cumulating the material at the end of the year and issuing it in one or more bound volumes, after which the monthly numbers, printed on less costly paper, can be discarded, used by the subscriber for making special bibliographies, or otherwise utilized. In the cumulated volume the material having appeared under a given section in the monthly numbers would be brought together and subjected to a more detailed classification than is practicable in the monthly issues—a classification as detailed as a careful consideration of the needs of the various groups may dictate. In addition to the more detailed classified cumulated arrangement, the annual volume or volumes would contain detailed alphabetical subject and author indexes, which have proved of such exceptional utility and supplement the classified arrangement in an important way, as instruments for locating desired information.

The committee is informed that the cumulated bound volumes would increase the estimated cost given above about 25 per cent., or a total for the monthly numbers and the annual cumulated volumes of $69,380.00.

Leaving the estimated annual income from 1,000 institutional subscribers the same, namely $15,000, the balance of $54,380 of the total manufacturing cost to be met by individual support, should each of the 6,000 individuals who are members of the societies invited to adhere to the Union support of a unified system, would be about $9.00 per individual. (This cost to the individual is well below that of the uncumulated journal bound by the subscriber; the large saving on wholesale binding more than offsets the added cost due to the cumulation.) It needs to be borne in mind that under a system of uniform support this sum would secure for the individual a monthly current abstracting journal and an annual classified and indexed master key to the world's biological literature, the latter bound in two volumes and fully ready for use without further expense of any kind.

The exigencies of the case require that the financial responsibility for such an enterprise be assumed initially largely by the workers in America, an obligation which can not well be shirked at this time, especially in view of the benefits which have for so long been reaped by American workers from the responsibilities carried in Europe. But assuming that there will be such assurances from American biologists as to make the venture financially possible, it is clear that the successful production of such a comprehensive service, *i.e.*, the prompt and adequate abstracting of approximately all the world's biological literature, presupposes the widest cooperation among biologists everywhere. In this cooperation the relation to the enterprise of all collaborating biologists would be the same, as now is the case in *Abstracts of Bacteriology*, *Botanical Abstracts*, and other services, European and American. If undertaken, the initial years of the service would constitute a trial period from which such readjustments, both as regards character of the journal and its direction, should come as experience and changed conditions may dictate. Indeed, this degree of plasticity should constantly characterize the service.

A. Parker Hitchens,
D. R. Hooker,
C. A. Kofoid,
I. F. Lewis,
Representing the Union of American Biological Societies.
E. D. Ball,
C. E. McClung,
J. R. Schramm,
A. F. Woods,
Representing the Division of Biology and Agriculture of the National Research Council.

THE INTERNATIONAL UNION OF PURE AND APPLIED CHEMISTRY

The annual meeting of the Fourth International Congress of the Union of Pure and Applied Chemistry was held in Cambridge, England, on June 17, under the presidency of Sir William Pope, professor of chemistry of Cambridge University, and was attended by representatives from twenty-one countries, nearly four hundred members and guests being present at the annual banquet.

The meeting lasted four days and among the important decisions reached by the various committees were the following:

The Committee on the Reform of Nomenclature of

Inorganic Chemistry decided to constitute a permanent committee composed of the editors of the *Journal* of the Chemical Society, *Chemical Abstracts*, *Gazzetta Chimica Italiana*, *Helvetica Chimica Acta*, *Recueil des Travaux Chimiques des Pays-Bas*, and the *Bulletin* de la Société Chimique de France. Each country is to send its suggestions to these various publications which will be duly qualified to submit them for general discussion.

The writing of formulas of acids, bases and salts in each country should conform to the usual custom in any particular language, that is, in the countries of Anglo-Saxon languages one would write HCl, H_2SO_4, $BaCl_2$, Na_2SO_4, $Ba(OH)_2$, etc., whereas in the countries of Latin languages one would write ClH, SO^4H^2, SO^4Na^2, Cl^2Ba, $(HO)^2Ba$, but in the same language one should not write sometimes ClNa and sometimes NaCl, nor sometimes SO^4Na^2 and sometimes Na_2SO_4.

The word hydrate will be reserved for combinations containing H_2O like the hydrate of chlorine, Cl_2 n H_2O; the hydrate of sodium sulfate, Na_2SO_4, $10H_2O$; the word hydroxide will be reserved for chemical combinations containing OH; aluminum hydroxide, $Al(HO)_3$; barium hydroxide, $Ba(OH)_2$.

The Committee for the Reform of Nomenclature in Organic Chemistry decided to increase the permanent committee composed of the editors of the *Journal* of the Chemical Society, *Chemical Abstracts*, *Bulletin* de la Société Chimique de France, by adding the editors of the *Gazzetta Chimica Italiana*, of the *Helvetica Chimica Acta* and of the *Recueil des Travaux Chimiques des Pays-Bas*.

The Geneva nomenclature will be used as basis for new proposals.

The Committee on the Reform of the Nomenclature of Biological Chemistry adopted the following resolutions dealing with the most general names:

1. The name of a new compound of which the chemical constitution is known must be made up in accordance with rules of nomenclature of organic chemistry;
2. The word *glucid* will be used to designate the group of substances which comprises the simple reducing sugars and substances which give one or several of these sugars by hydrolysis;
3. The word *lipoid* will no longer be used;
4. The word *lipide* will designate the group of substances which comprises the fat bodies and esters which possess analogous properties (lecithines, phosphatines, etc.);
5. The word *protide* will designate the group of substances which comprises the natural amino acids and substances which by hydrolysis give one or more of these acids.

The Committee on Bibliography recommended:

That the bureaus of documentation unify as much as possible their methods of work in accordance with the principles adopted by the International Institute of Bibliography and the Subcommittee on Bibliography of the League of Nations;

That in view of the resolution of the Subcommittee on Bibliography of the League of Nations, the chemical publications send at least two copies and preferably five copies of their annual index to the "International Institute of Bibliography" in order that this institute be in a position to draw up the "Central Annual Bibliographical Index of Authors' Names";

That the general secretary of the union make every possible effort to persuade those publications which have not yet come to a decision to conform with the two following resolutions which were passed at the previous congress;

That all original papers in chemistry should bear the address of the author or that of the laboratory where the work was carried out;

That the journals give a résumé of their articles in one of the languages accepted by the editorial board of the "Annual Table of Constants," in such a form that it could be published in an abstract journal.

The Committee on Physico-Chemical Standards recommended:

That the Bureau of Physico-Chemical Standards investigate, through circular letters addressed to the directors of the research laboratories, what are the new physico-chemical standards; the preparation of which would be most urgent.

The Committee on Pure Products for Research, in answer to the question asked by the International Oceanographic Association of the Mediterranean, replied that pure sodium chloride may replace standard sea water for the volumetric determinations actually in use in oceanographic work.

The Committee on the Bibliography of Industrial and Technological Products recommended:

That the Bureau of Vegetable Raw Materials, which is actually working in France, be incorporated in the Bibliographic Bureau of Industrial and Technological Products and that the Musée de la Faculté de Pharmacie de Paris and the Laboratoire Central d'Etudes et d'Analyses des Produits Médicamenteux et Hygiéniques (Laboratoire de la Commission du Codex) be incorporated in the Central Office.

The name of these united bureaus shall be "Service de Documentation sur les Matières Premières et les Produits Industriels" (Bureau of Bibliography of Raw Materials and Industrial Products).

The Committee on the choice of a Thermochemical Standard took note of the decision reached by the Bureau of Standards, Washington, that the benzoic acid prepared by this bureau can not be obtained as standard substances for calorimetric determinations except for purely scientific purposes and that it be-

comes therefore necessary to employ for technical purposes, in the determination of heats of combustion of solid and liquid fuels, benzoic acid from other sources. The committee will eventually draw up specifications for the approval of samples of benzoic acid.

The adoption of the conversion factor 1 cal. 15° = 1.184 joules was also recommended.

The Committee on the Tables of Constants recommended the following changes regarding physico-chemical symbols:

Molecular rotation is to be defined by the relation

$$(\mathrm{M}) = \frac{\mathrm{M} \times (\alpha)}{100}$$

the employment of "ω" for the specific magnetic rotation and "Ω" for molecular magnetic rotation is recommended; the molecular magnetic rotation is to be defined by the relation

$$(\Omega) = \frac{\mathrm{M} \times (\omega)}{15}$$

The committee further recommended:

That a subcommittee be appointed, composed of Professors Cohen, Findley, Marie and an American member to be designated by the National Research Council. This committee is to consider further changes and additions in physico-chemical symbols.

The Committee on the Study of Ceramic Products adopted the definition of the word "ceramic" and the classification of various products under that name as adopted by the American Ceramic Society.[1]

The Committee on Food Preservation requested:

That the subcommittee of five members, composed of Messrs. Alsberg, Bordas, Paterno, Pondal, Voerman, present at the next congress a general report on the bibliography which has been gathered up to the present and which could be assembled from now until then in regard to all matters relating to food legislation in the various countries;

Also that at the next congress the delegates of the various countries, taking into consideration the legislation in force at the time, present their conclusions of the effects of employing the following products as food preservatives: benzoic acid, boric acid, salicylic acid, sulfurous acid; sulfates and formaldehyde; for the purpose of undertaking a systematical and physiological investigation on the possibility of using chemical products in food preservation.

The Committee on Scientific and Industrial Ownership presented the following resolutions:

1. The committee, considering that in the Latin group, which is composed of countries granting patents without examination, the unification of legislation appears to be more capable of realization than in the others, invites these countries to begin a grouping as soon as possible with the idea of forming a Union of Uniform Legislation;

2. Considering that the original purpose toward which one must work should be to permit research workers to protect their discoveries and considering that on the other hand research workers can not carry out their researches in secret but must on the contrary be able to publish the results of their work as they are obtained;

The committee resolved:

That it is inadmissible that one should oppose to the holder of the applicant of a patent the results of his own work during a certain period of time after it has been published;

3. The committee declares that a purely scientific discovery should be legally protected;

4. A proper definition of this new legal right will be studied by the committee;

5. In order to secure the coordination of all efforts the president of the committee is appointed as a delegate to the Committee on Intellectual Coöperation of the League of Nations and to the International Chamber of Commerce to present and uphold the views of the committee.

The Committee on Industrial Hygiene requested the council of the International Union to give a prize for the best published essay on smokes, gases, fogs and noxious vapors to be met with in manufacturing; their elimination; the protection against their effects. The essays submitted should be general and descriptive in character, should include the latest progress in their particular subject and should be within the reach of the general reading public.

The committee also requested that the council of the union should establish a prize to be given to the inventor of an apparatus of recent construction for the suppression of smoke. In case no recent inventor could be found the prize should be given to that person who had done the greatest amount of work and obtained the best results on the problem of the suppression of smoke.

The committee planned to report at the next congress forms of apparatus intended to combat incipient intoxication from poisonous gases in factories and to gather a bibliography of legislation concerning industrial hygiene in various countries and analytical methods for the determination of hydrofluoric acid in smokes and vapors with special reference to superphosphate manufacture.

All these resolutions and recommendations were duly approved by the council and by the general assembly. The congress decided to meet in Copenhagen in 1924. Two new vice-presidents were elected, Professor Ernest Cohen (Netherlands) and Dr. Sakurai (Japan).

The congress decided in closing to create a committee to cooperate with those organizations which undertake to exchange students and professors be-

[1] Journal of the American Ceramic Society, Vol. III, 526 (1920).

tween the universities of the various countries with the idea of cooperating with these organizations and of bringing about such exchanges among professors of chemistry.

J. E. ZANETTI

SCIENTIFIC EVENTS

THE OPTICAL SOCIETY OF AMERICA

THE Eighth Annual Meeting of the Optical Society of America will be held at Cleveland, Ohio, Thursday, Friday and Saturday, October 25, 26 and 27. Hotel headquarters will be at the Hotel Cleveland. All sessions for the reading of papers will be held in Room 86, Physics Building, Case School of Applied Science, and are open to all persons interested in optics.

The address of the retiring president, Dr. Leonard T. Troland, will be on "The Optics of the Nervous System." Professor A. A. Michelson will read, by invitation, a paper on "The Limit of Accuracy in Optical Measurement," and Mr. Frederic Allen Whiting, director of the Cleveland Museum of Art, will address the Society on "The Optical Problems of an Art Museum." Mr. M. Luckiesh and Mr. A. H. Taylor, of the Nela Laboratory of Applied Science, will give a demonstration of new apparatus for the projection of mobile colored patterns. There will be a full program of contributed papers and committee reports, on general optics, vision, colorimetry, photometry, spectroscopy and instruments.

Arrangements are being made for visits to: The Nela Research Laboratories, The National Lamp Works, Warner and Swasey and The Cleveland Museum of Art.

The advance program containing abstracts of papers will be mailed to all members about October 5 or 10. In so far as the number of copies available may permit, it will also be mailed to others on request, addressed to the secretary, Irwin G. Priest, Bureau of Standards, Washington, D. C.

Since there are other large conventions in Cleveland at the same time, hotels are likely to be crowded, and members and others expecting to attend are advised to make their hotel reservations at once. Dr. W. E. Forsythe, Nela Research Laboratories, Nela Park, Cleveland, is chairman of the Local Committee on Arrangements for the meeting.

IRWIN G. PRIEST,
Secretary

EXPLORATION OF SAN JUAN COUNTY, UTAH

AN expedition sent out by the National Geographic Society, which has been assembling its personnel and equipment at Gallup, New Mexico, started on September 17 for a reconnaissance of the San Juan country of southeastern Utah, hitherto unexplored.

Leaving Gallup the party used automobiles, carrying its supply of gasoline in drums to Kayenta, Arizona, and then planned to travel on horseback across the Utah line into a land of knife edge canyons, bold buttes and green-topped mesas until the pack animals encounter impassable barriers. Then it will proceed on foot.

The expedition will attempt a preliminary survey of the region between the Colorado and San Juan rivers, much of it never traversed by white men, which constitutes one of the largest unexplored areas in the country. The area of observation lies within San Juan County, a county which is larger than the State of New Jersey.

Dr. Neil M. Judd, archeologist, of Washington, leader of the National Geographic Society expeditions which excavated and studied the pre-Columbian communal dwellings of Chaco Canyon, New Mexico, heads the Utah expedition. Accompanying Dr. Judd is Edwin L. Wisherd, a staff photographer of the society, and a party of assistants and guides.

Dr. Judd's primary attention, on his reconnaissance, will be to determine whether the cliff dwellings and skeletal remains, the traces of pottery, basketry and cliff inscriptions believed to abound will justify other larger expeditions of the society which shall include experts in every phase of scientific inquiry which the area warrants.

Evidence of the outskirts points to cave dwellers, as well as cliff dwellers in this territory, for early Indians seem to have found shelter in the egg-shaped and shell-smooth caves of the vari-colored rock.

The fantastic beauty of this rugged desert, with its red rock gashes, its ever-changing color, and gargoyle promontories offers exceptional photographic opportunities; and it is possible that an incidental result of the trip will be the finding of such other spectacles as the natural bridges and rocky spires which occur in contiguous areas.

A NEW WILD LIFE PRESERVE

THAT many of our handsomest and most desirable native plants are becoming increasingly scarcer has been a matter of observation for many years. In a number of localities such exquisite plants as rhododendron, arbutus, fringed gentian, lady's slipper and various species of wild lilies have become practically extinct due to cultivation, grazing, drainage, lumbering and the promiscuous picking of flowers. One of the remedies frequently suggested by plant conservationists is the establishment of wild-life sanctuaries or preserves in which the endangered species can grow without molestation.

The efforts of the conservationists seem to be bear-

ing fruit, since a number of such wild life preserves have been established during recent years. The latest addition to the ranks is the Herbert Davis Forestry Farm which was recently bequeathed to the people of Indiana by Martha F. Davis in accordance with the wishes of her husband, Dr. Lewis Nelson Davis, who died a few years ago. The farm, which comprises a total of 385 acres of fertile land located near Farmland, Randolph County, Indiana, contains a sixty-acre tract of virgin timberland. The will by which the property was deeded to the citizens of Indiana states that the wooded area must be "treated as a forest preserve to be an example of Indiana's native forest, preserving native trees and plants in their natural condition." The will further states that the forest land must be kept in such condition that it will "be a refuge for all song birds and other useful birds, especially quail." Since Purdue University is a state institution the farm, with its wild life preserve, has been placed in the keeping of the trustees of the university. According to the terms of the will Purdue University is vested with the responsibility to "keep from becoming extinct our fine native wild flowers, medicinal plants and trees."

The Davis preserve is a fine example of virgin Indiana forest that is probably little changed since the time of the early settlers. The dominant vegetation is a rich growth of magnificent white and black oaks with a sprinkling of hickory, ash, maple, elm and paw-paw. One majestic white oak towers over a hundred feet into the air and is supported by a sturdy base over twenty feet in circumference. The undergrowth contains such attractive species as the nodding trillium, flowering dogwood and wild geranium.

In keeping with the trust imposed upon them the authorities at Purdue University who are actively in charge of the project have formulated plans providing for the stocking of the woods with lady's slipper, fringed gentian, wild lilies and other desirable species that are worthy of protection. By this means it is hoped to preserve some of Indiana's endangered native plants for the pleasure and profit of future generations.

Albert A. Hansen

Purdue University

PRIZES IN CHEMISTRY

As has already been noted, Mr. and Mrs. Francis P. Garvan, in memory of their daughter, Patricia, have established prizes and scholarships in chemistry under the auspices of the American Chemical Society. Mr. Garvan writes:

In order that the youth of our country may have an intelligent appreciation of the vital relation of the development of chemistry to our national defense, for the intensification and purification of industry and agriculture, and to the progress of medicine through the "Age of Chemistry" upon which we have entered, and in memory of our daughter, Patricia, Mrs. Garvan and I tender to you the sum of $10,000. Six thousand dollars is to be expended by you in offering to each state six prizes of $20 in gold to students in all secondary schools, public and private, for the six best essays evidencing an understanding of the importance of chemistry in our national life. The remaining $4,000 is to defray the expenses of the contest.

In addition, we place at your disposal among the successful contestants in all the several states the awarding of six four-year scholarships in chemistry or chemical engineering at Yale University or Vassar College. These scholarships will carry $500 a year and tuition. The choice of subjects, all rules and regulations governing the contests, the awarding of the prizes, scholarships, etc., are to be under your absolute control and direction.

On authorization of the council of the American Chemical Society, Edward C. Franklin, president, has named H. E. Howe chairman of the contest committee and W. D. Bancroft, Charles H. Herty and Alexander Williams, Jr., as the other members of the committee.

Essays must be submitted before April 1, 1924. Winners will be announced not later than July 1, 1924. Essays must not exceed 2,500 words, and must be on one of these subjects: "Relation of Chemistry to Health and Disease," "Relation of Chemistry to the Enrichment of Life," "Relation of Chemistry to Agriculture and Forestry," "Relation of Chemistry to National Defense," "Relation of Chemistry to the Development of the Industries and Resources of Your State."

SCIENTIFIC NOTES AND NEWS

This number of Science is the fifteen hundredth under the present editorship.

The autumn meeting of the National Academy of Sciences will be held at Cornell University, Ithaca, N. Y., on November 12, 13 and 14.

Dr. David Starr Jordan, chancellor emeritus of Stanford University, has been elected president of the Pacific Division of the American Association for the Advancement of Science.

Dr. L. O. Howard, chief of the Bureau of Entomology, has been appointed president of the International Conservation Conference to be held at Honolulu in 1924 under the auspices of the Pan-Pacific Union.

On the occasion of the Pasteur Centenary, the French Government conferred upon Dr. Simon Flexner, director of The Rockefeller Institute for Medical Research, the rank of commander of the legion of honor.

Dr. Andrew Balfour, for the past ten years

director-in-chief of the Wellcome Bureau of Scientific Research, London, resigns that position on October 31. He will be succeeded by Dr. C. M. Wenyon, who for the past nine years has been director of research in the Tropics at the Wellcome Bureau of Scientific Research.

PROFESSOR J. M. WILLARD, head of the Department of Mathematics at the Pennsylvania State College, has, after thirty years continuous service, sent in his resignation on account of ill health.

DR. EDWARD H. MARSH, Brooklyn, has been appointed secretary of the New York State Department of Health to succeed Curtis E. Lakeman. Dr. Marsh is assistant professor of preventive medicine at Long Island Hospital Medical College and lecturer on hygiene in the University and Bellevue Hospital Medical College.

E. H. DARBY, formerly of the Department of Chemistry, Union College, Schenectady, N. Y., is now head of the research department, Rome Wire Co., Rome, N. Y.

JOSEPH S. BATES, formerly manager of the research division of the Marcus Hook, Pa., plant of the National Aniline and Chemical Co., is now with the Textile Service Co., Philadelphia, Pa.

FRANK B. GORIN, formerly of the Chemical Warfare Service, who for the past year has been making a survey of the facilities of the American dye and chemical industries, has been appointed chief of the heavy chemicals section of the Chemical Division, Bureau of Foreign and Domestic Commerce.

RODERICK K. ROONEY, formerly assistant professor of chemistry at the New Jersey College of Pharmacy, Newark, N. J., is now connected with the research and development staff of Lehn and Fink, pharmaceutical chemists and manufacturers at Bloomfield, N. J.

RALF R. WOOLLEY, hydraulic engineer of the United States Geological Survey, will represent the Federal Power Commission in the development of the Flaming Gorge site on the Green River. Mr. Woolley last year surveyed the Flaming Gorge district of Utah for the Geological Survey.

DR. GRINNELL JONES, of the division of chemistry, Harvard University, has returned to Cambridge from Washington, where since July 1 he has been assisting the Chemical Division of the U. S. Tariff Commission.

DR. NICHOLAS KOPELOFF, bacteriologist, of the Psychiatric Institute, Ward's Island, New York City, has been granted a year's leave of absence to do research at the Pasteur Institute and visit the laboratories of the Continent.

DR. GEO. T. HARGITT, professor of zoology, Syracuse University, has been granted leave of absence during the current year, and will devote his attention to research at the Wistar Institute of Anatomy and Biology, Philadelphia.

PROFESSOR AND MRS. T. D. A. COCKERELL, of the University of Colorado, returning from Siberia, were on board the *Empress of Australia* in Yokohama harbor when the earthquake occurred. They were not injured. The *Empress of Australia* being disabled, they were transferred to the *President Jefferson*. The U. S. entomologists working on the Japanese beetle (Popillia) were not in Yokohama at the time of the earthquake. The Plant Quarantine Station was destroyed, but Dr. Kuwana was absent in Corea.

DR. A. S. HITCHCOCK, systematic agrostologist of the United States Department of Agriculture, Washington, D. C., passed through Quito recently on his way to Banos and regions around Cuenca, Ecuador. Dr. Hitchcock is making three collections—one for the Gray Herbarium, one for the New York Botanical Gardens, and one for the National Herbarium, Washington. After leaving Ecuador, he will continue collecting in Peru and Bolivia. He expects to return to the United States about the first of February, 1924.

PROFESSOR NIELS BOHR, of Copenhagen, attended the Liverpool meeting of the British Association and lectured on the new element, "Hafnium." He was accompanied by Dr. Hevesy and Dr. Coster, both of whom presented papers at Liverpool. Two other prominent Danish scientific men were present at the meeting: Professor Schmidt, who spoke on the results of the Dana expedition, which studied the wanderings of the eel, and Professor Jespersen, who lectured on English grammar. On leaving Liverpool Professor Bohr expected to go to Canada and the United States at the invitation of American universities.

THE Government of New South Wales has asked Professor A. F. Barker, head of the department of textile industries at Leeds University, to prolong his stay in Australia. Professor Barker went there at the invitation of the New South Wales Government to take part in the Pan-Pacific Science Congress.

MR. C. BARRINGTON BROWN has recently brought home and has presented to the Sedgwick Museum of Geology at Cambridge a collection of Tertiary and Carboniferous fossils from the Amotape Mountains, near Cabo Blanco, in northwest Peru. These fossils are being studied by Mr. H. D. Thomas and Mr. A. G. Brighton. Mr. Brown is shortly returning to Peru to continue geological work and to complete a study of an early Pleistocene whale-bed which he discovered last year.

LAUGE KOCH, the Danish polar explorer, who started in March, 1921, on an expedition to Greenland, expected to arrive home on September 26, having succeeded in completing the task of charting far north Greenland, which he commenced on the second Thule expedition in 1917.

THE widow of the late Surgeon General William C. Gorgas is collaborating with Burton J. Hendrick, author of "The *Life* and Letters of Walter H. Page," in preparing a biography of General Gorgas. It is hoped to be able to publish the biography during the coming year.

THE July issue of *Health News*, the monthly bulletin of the New York State Department of Health, is a memorial to Dr. Hermann M. Biggs, state health commissioner from 1914 until the time of his death. Among those who have contributed in recognition of the services of Dr. Biggs are: Drs. Matthias Nicoll, Jr., T. Mitchell Prudden, William H. Park, Simon Flexner, H. Homer Folks, Linsly R. Williams and L. Emmett Holt.

DR. CHARLES FREDERICK MILLSPAUGH, curator of the department of botany of the Field Museum, Chicago, and professor of botany at the University of Chicago and the Chicago Medical College, died on September 15, aged sixty-nine years.

PROFESSOR LEROY CADY, associate professor of horticulture in the University of Minnesota college of agriculture, died on September 12 in St. Paul. Professor Cady was taken ill at the Minnesota State Fair, where he was assistant superintendent of the horticultural display.

JOHN HOWARD ROWEN, associate professor of mechanical engineering at the University of Minnesota, a retired naval officer with the rank of commander, died at Minneapolis on September 10.

THE death is announced at Manderscheid, Germany, on August 23, of Major Ernest Francis Bashford, M.D., O.B.E., late director of the Imperial Cancer Research Fund and adviser in pathology to the British Army on the Rhine, at the age of fifty years.

THE third congress of Industrial Chemistry will open in Paris on October 22, at the Conservatoire National des Arts et Métiers under the presidency of M. Dior, minister of commerce.

TRANSFERENCE of the plant of the Oregon State Bureau of Mines and Geology has been made to the School of Mines of the Oregon Agricultural College. It will be stored to meet the emergency caused by failure of the state legislature to appropriate money to pay for maintenance for the biennium 1923–1924. The plant includes library, reports and equipment.

WE learn from the London *Times* that the work of erecting a suitable building to house the Imperial College of Tropical Agriculture at Trinidad is proceeding. The new two-story structure of ferro-concrete will be completed by October, 1924. The college is temporarily housed in a building at St. Augustine, where there are six commodious class-rooms. It is proposed to add four other class-rooms to meet the needs of the institution, as it has been decided to increase the staff of professors and their assistants. During the last session eleven students were being trained, two of these holding scholarships offered by the British Cotton-Growing Association. One of the latter has already been appointed to Nyasaland.

MRS. C. L. HUTCHINSON, president of the Illinois Chapter of the Wild Flower Preservation Society of America, writes that the following act passed by the last Illinois legislature is now in effect:

> Any person, firm or corporation who shall, within the State of Illinois, knowingly buy, sell, offer or expose for sale any blood root (Sanguinaria Canadensis), lady slipper (Cypripedium parviflorum, and Cypripedium hirsutum), columbine (Aquilegia Canadensis), trillium (Trillium grandiflorum, and Trillium sessile), lotus (Nelumbo Lutea) or gentian (Gentiana crinita and Gentiana Andrewsii), or any part thereof, dug, pulled up or gathered from any public or private land, unless in the case of private land the owner or person lawfully occupying such land gives his consent in writing thereto, shall be deemed guilty of misdemeanor, and shall be punished by a fine of not less than \$10.00 nor more than \$100.00 and costs.
>
> All prosecutions under this act shall be commenced within six months from the time such offense was committed and not afterwards.

THE Committee of British Ophthalmologists appointed to organize an International Congress in 1925 finds, with regret, that it is unable to do so in accordance with the conditions under which the British invitation was accepted by the Washington Ophthalmological Congress in 1922. At Washington it was decided that the next congress should be strictly international and that German should be one of the official languages. The committee has since been informed that the Société Française d'Ophthalmologie, the Société d'Ophthalmologie de Paris and the Société Belge d'Ophthalmologie have passed resolutions to the effect that they feel themselves unable to participate in a congress if Germans are invited. The committee is of opinion that to proceed with the congress in these circumstances would tend to perpetuate a schism in the ranks of ophthalmology and militate permanently against the progress of the science, which all desire to promote. The committee has, therefore, reluctantly decided to postpone the congress.

THE twenty-second Flemish Medical Congress was held at Antwerp on August 11 and 12. The following papers were read: The physiology of the heart, by Professor H. Zwaardemaker, of Utrecht; extracardial influences on the heart, by Professor E. de Somer and Dr. P. Maeyer of Ghent; intracardiac arrhythmia, by Dr. S. de Boer of Amsterdam; pharmacodynamics and clinical administration of cardiac drugs, by Dr. U. G. Bijlsma and Dr. M. J. Roessingh of Utrecht; radiology of the heart, by Dr. M. Peremans of Antwerp; heart disease in pediatrics, by Dr. J. Lebeer of Antwerp.

UNIVERSITY AND EDUCATIONAL NOTES

FORTY-FIVE square blocks of Berkeley's most beautiful homes on the campus of the University of California up the hill slopes, north and east, were devastated by the fire on September 17, which is said to be the worst experienced by any California city since the San Francisco disaster of 1906. The fire was one of a series of forest, brush and grass fires, fanned by strong north winds and fed by undergrowth baked to a tinder by the prolonged summer. Such fires raged in nearly every county in Northern California. The buildings of the university were not harmed though it seemed at one time as if they would be destroyed. The homes of more than half the faculty and seven fraternity and sorority houses were burned. A shift in the wind then turned the course of the flames back over the burned area and many threatened buildings were saved.

AT the University of Buffalo instruction in the sciences fundamental to dentistry will be given hereafter in the departments of anatomy, biochemistry, pathology, pharmacology and physiology of the School of Medicine. To care for these increased responsibilities in the department of anatomy, of which Professor Wayne J. Atwell is the head, the following additions to the staff have been made: Dr. Rufus R. Humphrey, formerly of Cornell University, associate; Walter F. Greene, of Yale University, associate, and Ernest B. Hanan, of the University of Missouri, instructor.

THE work of preparing future executives for the oil industry will be undertaken by New York University. The course will be under the direction of Professor Ernest R. Lilley and credits toward a university degree will be given.

PROFESSOR Z. P. METCALF, head of the department of entomology and zoology of the North Carolina State College, has been appointed director of instructional work in the school of agriculture.

WILLIAM A. NEWTON, B.S. (McGill), Ph.D. (California), has been appointed assistant professor of botany at Pomona College. George M. Turner, specialist in petroleum, will be next year visiting professor of chemistry.

ARTHUR LL. HUGHES, research professor of physics in Queen's University, Kingston, Canada, has been elected Wayman Crow professor of physics at Washington University, St. Louis, to succeed Professor Arthur H. Compton, who goes to the University of Chicago.

DISCUSSION AND CORRESPONDENCE

THE NEEDS OF GERMAN SCIENTIFIC MEN

IN connection with certain scientific work, it was incumbent on me to make a special trip to Germany this summer to confer personally with one of the most eminent and renowned scientists of that land, who was professor of physiology in a famous German university. I had never been to Germany before and had never had the privilege of meeting the distinguished man whom I was on my way to see. Indeed, we had little in common, because our primary interests were in different realms of science. As soon as he heard of my arrival in the little university town where he lived, he invited me and my son (who accompanied me on my journey) to have afternoon tea at his home, whither we repaired at the appointed hour. It was a charming old house which spoke everywhere of refinement and culture and comfort. The professor and his wife met us at the threshold and bade us welcome in the most hospitable manner. On the table at which we sat down there was a little black bread and one or two unappetizing dishes. My host apologized for the meagre repast, saying simply that nowadays they were reduced to great extremities for food. His wife added that they had had no butter or milk or eggs for months, but occasionally they contrived to get a little meat, usually horseflesh, and sometimes a bit of coarse fish. I asked many questions about the domestic situation, but they were reluctant to talk about it. A girl named Marta waited on the table. She had lived with them twenty-five years or more, and each week she came to her mistress and implored her to reduce her wages, although they were not enough to buy a postage stamp. Madame took me aside after tea and cautioned me not to converse with her husband about the present distracted state of affairs. Every penny they had saved in a lifetime was gone; they owned the house in which they lived, but could not afford to keep it in ordinary repair. Her husband could not bear to talk about the desperate situation. His only relief from day to day was to try to bury himself in his work and shut out the ever-present fear of impending disaster as

much as possible. Even this slender resource was not available except in a limited way, because he lacked the apparatus and facilities for carrying on his researches and was almost entirely without recent books and current periodical literature.

The professor conducted me to his study, and there we talked about the special matters connected with my mission. With as much tact as possible, I ventured to express some sympathy with him on account of the conditions under which he and his colleagues had to labor, and volunteered to send him a few books and scientific journals when I got home, at the same time suggesting that perhaps he might write me and advise me how I might be of service in other ways.

A few days ago I got a letter from him referring to various subjects about which we had conversed; one paragraph of it was devoted to the question of aiding German scholars, in compliance with my request. I think conditions have grown rapidly worse since the middle of July when I was in Germany; otherwise, I doubt whether the writer would have alluded to the subject at all. The following is a translation of this portion of the letter:

When you were here this summer, you intimated that among your friends in America there were perhaps some who might be glad to be of aid in some way to German science and its votaries. In this connection you asked me to advise you what was the best way to accomplish this. After mature consideration and consultation with several of my colleagues, I venture to write you as follows on this subject:

Concerning the general scientific situation and needs, such as repair of college, supply of literature, etc., the best method seems to be through the centralized bureau for this purpose established in Berlin (Notgemeinschaft deutscher Wissenschaft, Berlin C2, Schlossportal 3). If you wish to do something special, perhaps you should direct your attention to the domestic needs to which I have alluded already. While this situation affects all of us more or less, naturally it bears more heavily on some than on others. Thus, for example, here in our community a small society has been formed for several years, known as *Dozentenhilfe*, which is in charge of my colleague, Professor Blank, and which is intended to afford temporary relief in cases of extreme need, although it is very inadequate for the purpose. To keep this society going seems to me to be the most important thing to be done at present, because as things are now nobody can foresee what the next months have in store for us and whether far harder and more widespread ills are not impending over us than any we have heretofore learned to bear. With the sudden depreciation of our currency, it is hardly necessary to say that checks and drafts should not be made payable in German marks.

Obviously, for many reasons it would be better to send actual articles of value, especially such necessary things as are needful for a rational and desirable life; because our condition is rapidly nearing the typical starvation stage (*da unsere Zustände sich rapide der typischer Hungersnot nähern*). The number of those things which have disappeared entirely from the market and which are no longer to be had for any money is continually increasing. However, help of this kind is so complicated and difficult to compass that it can not be done effectively on any large scale, after the organization already created for that purpose has ceased to exist.

With warm greetings to you and your son, in which my wife joins, I am, etc.

As the writer did not authorize me to publish his letter, I have felt constrained to suppress the name of his colleague, Professor Blank, and also of the university where the "Dozentenhilfe" is established; but I shall gladly supply this information to any individual who will apply to me for it.

It does not seem necessary to add further comments, as the letter speaks for itself. Germany as a nation may, and doubtless will, recover; but for many individuals, who in some instances are among the most gifted and useful men and women of this time, there is no recovery. Their life and work is as good as ended.

JAMES P. C. SOUTHALL
DEPARTMENT OF PHYSICS,
COLUMBIA UNIVERSITY

FURTHER OBSERVATIONS ON THE SEX CHROMOSOMES OF MAMMALS

IN the following note the results of two studies dealing with the sex chromosomes of mammals will be given briefly.[1]

In insect spermatogenesis the sex chromosomes frequently persist during the growth period as densely staining chromatin-nucleoli. In mammalian spermatogenesis it has been generally assumed that the chromatin-nucleoli were of the same character, and a number of observers have sought to determine the type of sex chromosome from a study of these bodies. Very conflicting conclusions have been drawn from a study of the same material, however, and recently Gutherz has presented evidence to show that in the white mouse the chromatin-nucleolus forms an autosome.[2]

In the opossum the writer has followed the chromatin-nucleolus from the time of its first appearance until the telophase of the first maturation division. It forms the X-Y sex chromosomes of the opossum. During the growth period, however, the nucleolus is extremely labile in character and may assume a great variety of forms none of which give any hint as to the final shape which will be assumed in division. Unlike the insects, the X and Y elements of mammals

[1] These studies were carried on under a grant given by the Committee for Research on Sex Problems, National Research Council.

[2] Gutherz, 1923, *Arch. f. mikr. Anat.*

are very intimately associated during the whole growth period.

The sex chromosomes of an old world monkey has been studied in spermatogenesis and in the somatic cells of embryos. The Rhesus maccacus males show 48 chromosomes, one of which is a small ball-like element with no mate of like size or shape, just as the writer found in man and a new world monkey.[3] In the first maturation division there are 23 tetrads and one chromosome made up of two very unequal parts, the larger (X) being rod-like and the smaller (Y) dot-like. The X and Y components segregate to opposite poles of the spindle, just as they do in the case of man.

The somatic cells of male Rhesus embryos (amnion) show consistently 48 chromosomes, including the ball-like Y element and the rod-like X element, neither of which have mates of like size or shape. Female embryos (chorion and brain cells) show consistently 48 chromosomes, but no Y is present and the X is paired.

In the three primates studied so far by the writer (man, a new and an old world monkey) the sex chromosomes have all been of the X-Y type, which were very similar both in form and behavior. The evidence for the Rhesus monkey is complete and makes it certain that the sex chromosomes of the other two forms have been correctly identified.

THEOPHILUS S. PAINTER
UNIVERSITY OF TEXAS

SCORPIONS IN NORTH DAKOTA

It is a well-known fact that scorpions are tropical in their distribution. The receipt in December, 1921, of three immature specimens, sent in by P. C. Arildson from Alexander, McKenzie County, North Dakota, near which point they were found in a lignite mine, was an occurrence of more than usual interest.

The appearance in certain newspapers of an account of the finding of scorpions in the state resulted in the receipt of several letters from persons in western North Dakota, who stated that scorpions had been seen several times previously. All these reports came from that general region known as the "Bad Lands."

Responding to my request for specimens a second instance was reported in the spring of 1922 and a single specimen was sent in from Oakdale, in Dunn County, North Dakota, with the statement that several had been seen near that place during the winter. A third instance of the kind was reported from Golden Valley County, when a single specimen was sent in from Trotters, North Dakota, in November, 1922. Both these localities are on the edge of the "Bad Lands."

All these specimens, except the last, have been referred to Dr. H. E. Ewing, U. S. National Museum at Washington. Dr. Ewing determined the scorpion as *Vejovis boreus* Gir., and wrote that the specimens sent were identical with others of this species from the old Marx collection in the museum, taken from Fort Pierre "Dakota" (South Dakota) years ago. According to Ewing (in litt.), "*Vejovis boreus* is represented in our collection by specimens from Lincoln, Nebraska; Indian Springs, Georgia; Gold Hill, Oregon; Soldier, Idaho; Fort Steele, Wyoming; Arizona; Salt Lake, Utah; and some other specimens with no locality."

Professor J. H. Comstock in his "Spider Book" records 23 species of known scorpions in North America. Of these only one, the species under consideration, is found at all in the northern United States. In the fourth provisional zone map of North America, published by the U. S. Biological Survey, small portions of western North Dakota are indicated as being included in the upper austral zone, the remainder of the state being in the transition zone. From the records at hand it seems likely that this species may belong to the upper austral. There seems to be no previous record in the literature of the occurrence of this order in North Dakota.

R. L. WEBSTER
NORTH DAKOTA AGRICULTURAL COLLEGE

QUOTATIONS

THE PRIESTLEY MEDAL

The first Priestley Medal of the American Chemical Society has been awarded to Dr. Ira Remsen, President Emeritus of Johns Hopkins University. His achievements in research have been principally within the field of pure science, his discovery of saccharin being little more than an incident among them. Of great importance have been his contributions to the linking of chemistry with medicine. Distinction is also his for his unwearying efforts—and success—in keeping the torch of chemistry alight in this country when the public either could not or would not see that there was illumination in the flame.

Returning from Germany in 1872, he became professor of chemistry at Williams College, where, after earnest pleading, he secured laboratory space eight by ten feet. But in 1876 Johns Hopkins invited him to go to Baltimore as professor, to do his own work in any way he pleased, assured that no one would interfere with him. His organization of the famous department of chemistry in that university has sometimes been referred to as the turning point in the science in the United States. In 1879 he brought out *The American Journal of Chemistry* and edited it

[3] *Journ. Exp. Zool.*, Vol. 37, p. 291, 1923; SCIENCE, Vol. LVI, p. 286, September 8, 1922.

continuously until 1914. His text-book on organic chemistry has been translated into many languages and is in use in many countries.

Greater than any other phase of his work has been his inspiration of the men whom he trained. To the younger students he appeared cold, distant, severe—an impression emphasized by his faultless dress, precise speech, perfect manner and dignified bearing. Later, when they became more familiar with the working of his mind, they perceived that this precision in habit and speech and gesture was, as a former student put it, "the polish of chilled steel and not a coat of varnish on wood." As soon as a student proved his interest in his work and showed a proper comprehension of what it meant he found Professor Remsen richly gifted with the ability to arouse curiosity and enthusiasm. It was then that reverence and affection began to grow together. The erstwhile cold and distant professor would gladly take hours in discussing a student's plans of study with him and count the time well spent.

The Committee on Award has done well to provide that the first Priestley Medal shall go to so great a teacher, so eminent a man of science, and withal so distinguished a gentleman and scholar.—*The New York Times.*

SCIENTIFIC BOOKS

A Comprehensive Treatise on Inorganic and Theoretical Chemistry. By J. W. MELLOR. Vol. I, 1065 pp, H. O; Vol. II, 894 pp, F, Cl, Br, I, Li, Na, K, Rb, Cs; Vol. III, 927 pp, Cu, Ag, Au, Ca, Sr, Ba. New York, Longmans, Green & Company. Price $20.00 per volume.

THE appearance of the first three volumes of this important work which "aims at giving a complete description of all of the compounds known in Inorganic Chemistry, and, where possible, these are discussed in the light of the so-called Physical Chemistry," permits a somewhat better estimate to be made of the value of the series (to contain six or seven volumes when complete) than was possible when only the first volume was available.

So unique a work in English has naturally attracted much attention, as is attested by the numerous reviews of the separate volumes which have appeared in the technical, and even in the popular press.

The first impression is one of admiration and wonder at the courage and industry of the author in attempting so tremendous a task, and the scientific world, particularly the English-speaking world, must be very grateful to Dr. Mellor for this important contribution to chemical literature.

Most large reference books have been written by a number of authors under the editorship of an individual or group; the present work represents a distinct departure from that system. Certain faults are inherent to either method. It is very difficult to bring about unity of treatment, and to avoid overlapping, where different chapters are written by different individuals; on the other hand, in the work of a single author it is almost inevitable that the treatise shall be somewhat colored by the individuality of the writer, and that emphasis shall be given to particular phases of the science in which he may be most interested. It can not be said that the "Comprehensive Treatise" has escaped entirely these latter faults, and they will seem more or less serious according to the individual who uses the book, and the purpose for which it is employed.

The method of treatment departs widely from the usual, the subject matter following almost the identical arrangement employed in the author's earlier text-book, "Modern Inorganic Chemistry," which the author declares in his preface to be an abridgment of the present work. The reviewer has already[1] expressed the opinion that this method of treatment is not a happy one. The elementary text-book, assuming little previous information on the part of the student, must of necessity limit its statements of theory to terms which may be understood by the student at that particular point in his development. This necessitates frequent incomplete treatment, which it is expected will be developed further at a later period. The same method in an advanced reference book leads to obvious disadvantages, for it means that the theoretical treatment will be subdivided and scattered. The first volume particularly of the "Treatise" illustrates this fault, for while entitled "Hydrogen and Oxygen," it really contains a large proportion of general historical and theoretical subject matter. As a characteristic example may be cited the section on "Valency," which gives a rather full discussion of the subject, but does not touch at all on the modern theory with its relation to atomic structure, as this subject is to be treated in a later volume. Similarly "Acids, Bases and Salts" are treated in the chapter on "Oxygen," but since the theory of electrolytic dissociation has not been introduced at this point, the subject is not discussed from this standpoint. "Equilibrium" is treated partially in Volume I but we find it somewhat amplified in Volume II under "Compounds of the Halogene with Hydrogen." "Colloids" are discussed under "Gold" in Volume III, but whether further attention will be paid to them will not be known until later volumes appear.

Numerous other examples may be cited, but these

[1] J. Am. Chem. Soc., 44, 1836 (1922).

may serve to illustrate what seems to the reviewer a serious fault in the treatment of theory, making it frequently incomplete, scattered and difficult to find.

The statistical information is much more satisfactory. An enormous amount of information is given, much of which is not available in any other reference book with which the reviewer is familiar. The historical method of treatment is employed, and an unusual amount of the older data is introduced. This may sometimes lead to a little confusion, as it is frequently followed by conflicting subsequent data, without comment by the author.

The references seem extremely full. They are given at the end of each minor subdivision, and may prove difficult to use unless a complete author index is to be included eventually. Many subjects are brought quite up to date; in others ten or twenty years may have elapsed since the latest reference quoted.

The style is that associated with the author's previous works—vigorous, entertaining, and interwoven with philosophy and humor, making the treatise unusually "readable" for a work of its type. In fact, it may be that it fulfills the purpose of providing outside reading for the advanced student better than most other purposes for which such a work may be used. Errors and misprints seem rare; rather curiously most of the errors which the reviewer has detected occur in the form of statements which say exactly the opposite of the author's intention. The book is very well printed and attractively designed. In the text words of particular importance are printed in heavy type, which aids the eye in locating particular subjects on the page.

The three separate volumes may be discussed briefly.

Volume I is somewhat introductory in nature, containing several historical chapters, together with such subjects as "The Physical Properties of Gases," "Solutions," "Crystals," "Thermodynamics and Thermochemistry," as well as the chapters devoted to "Hydrogen," "Oxygen" and their compounds. The volume is most satisfactory, in the opinion of the reviewer, in the purely historical chapters, and in the excellent chapters on "Ozone" and "Hydrogen Peroxide."

Volume II treats the halogens as a group, with comparison and contrast of their properties and those of their compounds, over four hundred pages being devoted to them. As an example of the large number of references it may be noted that seven pages of references in fine print follow forty pages of text on the subject of "Metallic Halogenates." The alkali metals (including ammonium compounds) are given treatment similar to the halogens.

Volume III treats "Copper," "Silver," and "Gold," separately and in much detail, while the alkaline earths are treated as a group.

Volumes II and III contain, naturally, a much larger proportion of statistical information than is the case with Volume I. They are therefore less subject to the criticisms indicated above, and seem to the reviewer more satisfactory for reference purposes.

On the whole the "Comprehensive Treatise" undoubtedly represents a most important contribution to chemical literature, and one that will prove invaluable to the investigator as a source of information and suggestion, and to the advanced student and teacher as a source of "outside reading" which will prove interesting and valuable.

The remaining volumes of the series will be awaited with much interest.

GRAHAM EDGAR

THE UNIVERSITY OF VIRGINIA

SPECIAL ARTICLES

A NEW OCCURRENCE OF THE BLACK-EYED YELLOW MUTATION IN RATS

IN 1914 a strain of black rats was developed in the animal colony of the Wistar Institute from several black individuals obtained in the F_2 generation of a cross between a wild Norway male and an albino female. The strain has been maintained through some 25 generations in which many hundreds of rats have been reared that have always bred true to type.

On January 14th, 1922, a litter of eight young was cast by a young black female that had been mated to a male taken at random from the black stock; all of these young later developed into seemingly pure blacks. Three days after the birth of this litter a ninth individual, apparently less than 24 hours old, was found in the nest. This individual, a female, was about to be discarded when it was discovered that the eye were a much lighter color than those of normal black rats at birth. It was reared by an albino female, and developed into a light grayish colored rat with dark red eyes. A color variety of this kind had never been seen in the colony.

When mature, this mutant female was mated with a "dilute gray" male.[1] The offspring of this mating, three males and two females, were all of the wild gray type, indicating that the new mutation was not one of the color-albino series of allelomorphs like dilution. When these grays were inbred they produced, among other color varieties, black-eyed yellow young. Yellow varieties of rats had previously been obtained only from the stock originally imported from England by Dr. Castle in 1914. As the Wistar colony

1 P. H. Whiting and Helen Dean King, "Ruby-eyed dilute gray, a third allelomorph in the albino series of the rat," *Jour. Expor. Zool.*, vol. 26, 1918.

contained none of these rats, Dr. Castle kindly sent several for breeding tests.

A mating of the mutant female with one of Dr. Castle's pink-eyed yellow males gave young of the wild gray type; with a black-eyed yellow male the offspring were all black-eyed yellows. The types of young produced in the F_2 generation of these crosses proved conclusively that the mutant female was a "cream" or non-agouti form of the black-eyed yellow rat. The formula for the mutant is aarr, when A is the agouti and R the normal dominant color factor in black-eyed yellow.

The parents of the mutant produced a total of six litters containing 57 young, of which five individuals, two males and three females, were creams; 14 creams was the number to be expected. The mother of the mutant when mated with another male from the black stock cast only black young.

The sire of the mutant was mated with three other females taken at random from the black stock. Two of these females produced a total of 76 young, among which there were thirteen male and six female creams; the other female cast 30 young that were all black. This male was later mated with three of his black daughters: two cast only black young; the other produced six male and seven creams in a total of 34 young. The four females that produced creams among their offspring cast a total of 167 young, among which there were only 37 creams, although one fourth of the number, or 42 creams, were to be expected.

Several matings were made between black sibs of the mutants, but only black young were obtained. No other matings in the black strain have, as yet, given any of the creams.

The black sire of these mutants was born in July, 1921. When taken for breeding he appeared to be pure black, but as he grew older marked color changes appeared in his coat. Patches of hair on the sides of the body became ticked, like the hair of wild Norways, and on the posterior part of the back the hair was dark brown; around the head the hair remained black. None of the females that cast cream young showed any pronounced changes in coat color. The male developed pneumonia early in 1923 and would no longer breed. An autopsy showed that one testis was atrophied; the other appeared normal and will be examined cytologically by Dr. Ezra Allen.

The appearance of cream young among the offspring of black parents indicates that both parents must have been heterozygous for the cream factor, otherwise cream, being recessive to black, would not have appeared in the offspring. When and how the mutant factor originated can only be a matter of conjecture. It may have existed in the germ cells of the wild Norway male from which the black strain was derived, and failed to affect the coat color of any of the offspring because matings were not made between individuals heterozygous for this factor. This supposition seems untenable, since the strain was closely inbred and a large number of individuals reared. It seems more probable that the cream factor appeared in the germ cells of a black rat only two or three generations back, and that the chance mating of heterozygous individuals brought out the mutant form.

Helen Dean King

The Wistar Institute of Anatomy and Biology

THE OHIO ACADEMY OF SCIENCE

The thirty-third annual meeting of the Ohio Academy of Science was held at Oberlin College, Oberlin, March 30 and 31, 1923, under the presidency of Professor Albert P. Weiss, of Ohio State University. Fifty-five members were registered as in attendance.

Dr. T. C. Mendenhall presented an appreciative memoir of Emerson McMillin, of New York City, whose death at the age of seventy-eight occurred on May 31, 1922. A member since 1892, and elected to fellowship in 1920, Mr. McMillin was always intensely interested in the work of the academy, although, so far as is known, he was never able to attend a meeting. Although he was personally unknown to the great majority of the present members, his generous contributions to the research fund, continued through a quarter of a century, have been a constant stimulus to the research spirit of the academy and the research work of its membership. Dr. Mendenhall's memoir appears in the May–June number of the *Ohio Journal of Science*.

Twenty-five new members were elected, and the following eight members were elected to fellowship: William Letchworth Bryant, Walter C. Kraatz, Paul Marshall Rea, Septimus Sisson, Warren N. Thayer, Roy Curtis Thomas, Lewis Hanford Tiffany, Edward L. Wickliff.

Officers for 1923–24 were elected as follows: *President*, K. F. Mather, Denison University; *vice-presidents—zoology*, W. M. Barrows, Ohio State University; *botany*, H. H. M. Bowman, Toledo University; *geology*, J. E. Carman, Ohio State University; *physics*, W. C. Devereaux, U. S. Weather Bureau, Cincinnati; *medical sciences*, B. M. Patten, Western Reserve University; *psychology*, H. A. Aikins, Western Reserve University; *secretary*, W. H. Alexander, U. S. Weather Bureau, Columbus; *treasurer*, A. E. Waller, Ohio State University.

The annual geological excursion, under the direction of the incoming vice-president for geology, Professor J. Ernest Carman, has been reported somewhat

fully in SCIENCE for June 15. The party visited the Pennsylvanian and Permian formations of Muskingum County, Ohio, on May 25, 26 and 27.

The scientific program was as follows:

PRESIDENTIAL ADDRESS

The aims of social evolution: ALBERT P. WEISS.

PUBLIC LECTURE

Trees as witnesses in boundary disputes—an instance of applied ecology: HENRY C. COWLES.

SYMPOSIUM ON GEOGRAPHICAL DISTRIBUTION

Geological factors in animal and plant distribution: G. D. HUBBARD.

Some factors in plant distribution: H. C. COWLES.

The distribution of vegetation in relation to physiographic provinces: E. LUCY BRAUN.

The places of origin of the several families of Anura: M. M. METCALF.

Factors which determine local distribution of spiders: W. M. BARROWS.

Some problems in the distribution of dragonflies: CLARENCE H. KENNEDY.

SYMPOSIUM ON CURRENT PROBLEMS OF OHIO GEOLOGY

Early Paleozoic stratigraphy: W. H. SHIDELER.

Middle Paleozoic stratigraphy: J. ERNEST CARMAN.

Stratigraphy of the Carboniferous formations: J. E. HYDE.

Paleozoic faunas and their correlation: A. F. FOERSTE.

Some work yet to be done in Ohio physiography: GEO. D. HUBBARD.

Economic geology: J. A. BOWNOCKER.

Structural geology: W. H. BUCHER.

PAPERS

Weather and human conduct: WILLIAM H. ALEXANDER.

Some Old World botanic gardens: A. E. WALLER.

Some features of the park area of the Cleveland metropolitan park district: E. L. FULLMER.

The Cleveland Museum of Natural History: P. M. REA.

An eagle observatory at Vermilion; results obtained in 1922: FRANCIS H. HERRICK.

A contribution to our knowledge of the life history and physiology of Euglena: W. J. KOSTIR.

The so-called allelocatalytic effect in the reproduction of Protozoa: W. J. KOSTIR.

The persistence of archaic parasites through many geologic periods: MAYNARD M. METCALF.

The origin of American opalinids: MAYNARD M. METCALF.

Two new cestode parasites in black bass of Ohio; life history, distribution, etc.: RALPH V. BANGHAM.

Life history studies of Homoptera: HERBERT OSBORN.

Jumping mouse, Zapus hudsonius, in Ohio: H. A. GOSSARD.

The geographic distribution of Arctic Bryozoa: RAYMOND C. OSBURN.

The inheritance of the nail-biting habit: W. M. BARROWS.

A case of extra digits in the manus of the pig: STEPHEN R. WILLIAMS.

On the origin of some embryonic abnormalities: R. A. BUDINGTON.

Comparative physiology as an undergraduate study: CHAS. G. ROGERS.

Physiological evidences of animal relationship: CHAS. G. ROGERS.

Lorain County Polyporaceae: F. O. GROVER.

The vegetation of Ohio: E. N. TRANSEAU.

Studies on the genus Ampelopsis: GRACE GILMOR.

Variations in the root system of the common everlasting, Gnaphalium polycephalum: HELEN GUHMAN.

Soil reactions and plant succession: E. LUCY BRAUN and SYLVIA GEISLER.

Importance of resistance of the host in the control of plant diseases: W. J. YOUNG.

Observations on the sexual state of various plants: J. H. SCHAFFNER.

The time of sex determination in plants: J. H. SCHAFFNER.

Some chemical changes accompanying growth and reproduction in Spirogyra: L. H. TIFFANY.

Flora of the muck land of Delaware County, Indiana: BLANCHE MCAVOY.

Notes on the distribution of sea grasses: H. H. M. BOWMAN.

Prairie openings on the Little Miami River: M. MILDRED IRWIN.

Concerning some ostracoderms from Ohio: J. ERNEST CARMAN.

The temperature and brightness of tungsten lamps: W. E. FORSYTHE.

Effect of tension on change of resistance and thermo-electromotive force by transverse magnetization: ALPHEUS W. SMITH.

DEMONSTRATIONS

Methods of recording bird migration: LYNDS JONES.

Drawings of penes of dragonflies: CLARENCE H. KENNEDY.

Preserved skin specimen of jumping mouse, Zapus hudsonius: H. A. GOSSARD.

A cent found in the pharynx of a cat from the comparative anatomy laboratory: STEPHEN R. WILLIAMS.

Microscopic slides illustrating paper on cestode parasites of black bass: RALPH V. BANGHAM.

Roots of the common everlasting, Gnaphalium polycephalum: HELEN GUHMAN.

Thorns of honey locust, Gleditsia triacanthos: F. E. BEGHTEL.

Twigs as a basis for winter tree study; a method of mounting: E. LUCY BRAUN.

Rainfall and vegetation map of Asia: GEO. D. HUBBARD.

Drawings of opalinids: MAYNARD M. METCALF.

Distribution maps of opalinids and their hosts: MAYNARD M. METCALF.

EDWARD L. RICE,
Secretary, 1922–23

DELAWARE, OHIO

SCIENCE NEWS

THE JULIAN CALENDAR

Science Service

MILLIONS of people who go peacefully to bed the night of September 30, according to their calendar, will "lose" 13 days before daylight comes next morning. The next day for them will be October 14, the beginning of the shortest month of their lives. Such is a result of the decrees of the "Pan-Orthodox Congress" of the various branches of the Eastern Orthodox Church at a meeting last spring, fixing a time for the final abandonment of the Julian Calendar which was for 1,600 years that of the Roman empire and of the entire Christian world and which in parts of the world has endured to this day. The change will occur at midnight, October 13, on our common or Gregorian calendar.

Julius Caesar was not a man with a great reverence for ancient customs just because they were old-fashioned. In his day the old Roman calendar had become so inaccurate that it was three months ahead of the sun; when the calendar said it was summer, the sun said it was spring, and festivals fixed by the calendar came at inappropriate times. Julius proceeded to do something about it. He called in Greek and Egyptian astronomers, and established the calendar that bears his name.

The old year had been just 365 days, but the astronomers found that the error in the calendar was due to the fact that the year as measured by the time between two successive norval equinoxes, or the moment when the sun crosses the celestial equator on its way north, was something longer than this, or about 365 days and six hours. So Caesar invented the Leap Year, adding an extra day every four years and thought the problem solved.

But astronomical science progressed, even during the so-called Dark Ages after the fall of Rome, and by the latter part of the sixteenth century when it was recognized there was a difference of some 10 days between the sun and the calendar, the remedy was also recognized. Pope Gregory XIII called a council of astronomers who, knowing the amount of the error in the method of the Julian Calendar, proceeded to correct it by eliminating one leap year at the end of every century except those for the years evenly divisible by 400. According to this rule 1900 was not a leap year, but 2000 will be.

The Gregorian Calendar was immediately adopted by the Roman Catholic world, but since the adoption of the Julian Calendar the Eastern churches had split away from Rome and acknowledged no allegiance to the Pope, while at the same time the Protestant Reformation was in progress in western Europe and for a long time the Protestant nations stuck to the old reckoning.

England, however, finally adopted the Gregorian calendar in 1752 and it became effective in the American colonies about the same time. The error in the Julian calendar was then 11 days and the day following, September 2, 1752, was called September 14. But the several branches of the Eastern Church and the nations where it was the dominant religion kept to the old calendar. Russia was the first to break away, the Soviet government adopting the western calendar in 1918; Roumania and Serbia followed in 1919. Among the nations outside of Christendom, Japan, China and Turkey had already followed the lead of the western world, leaving Bulgaria and Greece and the Greek Orthodox Church as the only adherents to the older system.

But where that church is strong, as in Russia and Roumania, there have been two calendars in operation, the religious and the civil, resulting in much confusion. It even affected vitally American industries which employed Eastern Europeans, since pious Orthodox workmen insisted on observing holidays for a second time, when the belated Julian calendar caught up with our own. This will end next month, and for the first time since 1582 the entire civilized world will be keeping the same time with one notable exception. The Ruthenian Catholics, or Uniates, as they are known in Europe, a body of Christians numbering some 8,000,000, of whom half a million are in this country, will still adhere to the astronomy of Julius Caesar. They dwell chiefly in the Russians Ukraine and in neighboring regions, and although they acknowledge the spiritual supremacy of the Roman church they dislike their Greek and Roman Catholic neighbors so heartily that they will not even have the same calendar and the same festival days as they do.

How long they will hold out is a problem; but as things are it seems that the Julian Calendar is doomed to ultimate extinction after having lasted some 1,962 years.

THE EINSTEIN THEORY

Science Service

CONFIRMATION of the third prediction of Einstein resulting from the application of his general theory of relativity was announced to the American Association for the Advancement of Science at its recent fall meeting at Los Angeles by Professor Charles E. St. John, of the astronomical staff of Mt. Wilson Observatory. The lines of the solar spectrum are not identical in position with those due to incandescent samples of the same elements when observed on the earth, and the displacement is toward the red end of the spectrum. This indicates a slowing up of the rate of atomic vibration, as predicted by Einstein, as a result of the difference of the position of the two samples of incandescent elements with reference to the gravitational field of the sun.

Einstein has stated that his theory of relativity stands or falls according to whether or not this effect is observed. Professor St. John has calculated that the displacements of the lines in the solar spectrum predicted by Einstein amount to 86 per cent. of the total observed effect, the remainder being due to other well-known effects resulting from conditions in the solar and terrestrial atmospheres and to the sun's rotation on its axis.

# SCIENCE

Vol. LVIII October 5, 1923 No. 1501

CONTENTS

SCIENCE: A Weekly Journal devoted to the Advancement of Science, edited by J. McKeen Cattell and published every Friday by

THE SCIENCE PRESS

Lancaster, Pa. Garrison, N. Y.
New York City: Grand Central Terminal.

Annual Subscription, $6.00. Single Copies, 15 Cts.

SCIENCE is the official organ of the American Association for the Advancement of Science. Information regarding membership in the association may be secured from the office of the permanent secretary, in the Smithsonian Institution Building, Washington, D. C.

Entered as second-class matter July 18, 1923, at the Post Office at Lancaster, Pa., under the Act of March 3, 1879.

THE QUANTUM THEORY*

One of the most surprising and interesting developments of the quantum theory is that which shows that quantum numbers determine not only the size and form of the electronic Keplerian orbits in atoms, but also the orientation of these orbits in space with regard to a favored direction such as that provided by an intra-atomic or by an external magnetic or electric field of force. For any arbitrary value of the azimuthal quantum number k, the simple theory shows that there are exactly $k+1$ quantum positions of the orbital plane characterized by whole numbers. For example, if $k=1$ the normal to the orbit may be either parallel to the direction of the controlling field or at right angles to it. If $k=2$ the normal to the orbit may take up in addition to these two positions a third one, in which the normal to the orbit makes an angle of 60° with the field. For higher values of the quantum number k, the possible orientations of the corresponding orbits become regularly more numerous.

A striking confirmation of this theory is afforded by the very beautiful experiments of Gerlach and Stern.[1] In these a stream of atoms of vaporized silver was allowed to flow past a wedge-shaped pole of an electromagnet which provided a radial non-uniform magnetic field. The atoms were caught on a glass plate placed immediately behind the pole, and it was found that they were deposited in two distinct sharply defined layers, indicating that the atoms were sorted out into two distinct and separate beams. The positions of the bands on the plate showed that one of the beams was attracted by the pole and the other repelled by it, the attraction being slightly the greater in intensity. No evidence was obtained of an undeflected beam. From these results it was concluded that all the silver atoms in the stream of vapor possessed a definite magnetic moment, and that while the atoms were passing through the magnetic field their magnetic axes had two distinct orientations in space.

By assuming the correctness of this interpretation, Gerlach and Stern found from measurements on the

* Concluding part of the address of the president of the Section of Mathematics and Physics, British Association for the Advancement of Science, Liverpool, September, 1923.

[1] Gerlach and Stern, *Zeit. für Phys.*, vol. 7, p. 249, 1921; vol. 8, p. 110, 1921; vol. 9, p. 349 and p. 353, 1922.

various magnitudes involved in the phenomenon that within the limits of error of their experiments the magnetic moment of the normal atom of silver in the gaseous state was that of one Bohr magneton.

Bohr, also, has drawn attention to another possible illustration of the principle of the quantization of orbits in space. It is known that all the rare gases do not exhibit the property of paramagnetism. From this fact the conclusion has been drawn that the atoms of these gases in their normal condition do not possess any angular momentum. According to the quantum theory, however, this conclusion may not be warranted, for we have seen that for an atom which has a finite angular momentum and, consequently, possesses a magnetic moment, the theory prescribes certain definite directions for the axis of momentum relative to a magnetic field in which the atom may be situated. If we assume that the atoms of the rare gases in a magnetic field can place themselves with their momentum axes perpendicular to the magnetic field, it follows that they could appear to be diamagnetic, and all indication of paramagnetism on their part would be absent. In this connection I may point out that Bohr has made the suggestion that evidence in support of the validity of this view is derivable from the results of an analysis, on the basis of the quantum theory, of the anomalous Zeeman effect shown by the rare gases.

One point that may be worthy of notice in dealing with phenomena associated with the principle of space quantization is that the permitted orientations depend only on the values of the quantum number involved, and not on the magnitude of the magnetic field applied.

Orbits characterized by certain definite values of the quantum number should take up their permitted orientations in weak magnetic fields as well as in strong ones, provided the time allowed for the process to take place was ample, and provided suitable pressures were used and disturbances arising from the presence of contaminating gases were eliminated. Such conditions as these have recently been realized by Gerlach and Schutz,[2] and they have been able to obtain with sodium vapor at low pressures in the absence of foreign gases remarkably striking manifestations of the magnetic rotation of the plane of polarization of the light passing through the vapor with magnetic fields as low as a few tenths of a gauss.

This idea of space quantization may perhaps throw some light on the interesting and suggestive experiments of R. W. Wood and A. Ellett[3] on the polarization of the resonance light emitted by mercury and sodium vapors. In their experiments, it will be recalled, strong polarization of the resonance light from mercury or sodium vapors could be produced by weak magnetic fields properly orientated. Moreover, they found that the polarization of the resonance light emitted by these vapors in the presence of the earth's magnetic field could be destroyed by applying a magnetic field of less than one gauss provided it was suitably orientated. It is highly desirable that the experiments of Wood and Ellett should be followed up in order that sufficient information may be gained to enable us to elucidate the principles underlying the modifications in the polarization of the resonance light observed by them.

It seems clear that atoms of sodium, for example, when excited by the absorption of resonance radiation would tend during the period of excitation to take up definite and characteristic orientations even in weak magnetic fields that would result in the polarization of the resonance radiation emitted being different from that of the radiation emitted from atoms of the vapor situated in space in which absolutely no magnetic field existed. It should be remembered, too, that in the normal atom of sodium the orbit in which the valency electron is bound has the value 1 for its characteristic azimuthal quantum number k. When the atom is excited by the absorption of resonance radiation the azimuthal quantum number of the orbit, in which the valency electron becomes bound for a time, takes on the value 2. It seems clear then that the electronic orbit of the valency electron may be subject to different orientations relative to the rest of the atom when the atom is in the excited state from what it would be with the atom in its normal state. These relative orientations, moreover, would again be different in the presence of even a weak external magnetic field from what they would be in the complete absence of such a field. It is, therefore, quite conceivable that changes in orientation of electron orbits may be able to account for the phenomena observed by Wood and Ellett, but at present the whole matter appears to be rather involved and rather difficult to clear up with the information as yet available.

Among the most fruitful of the principles utilized by Bohr in the development of his theory of radiation is the Adiabatic Hypothesis enunciated by Ehrenfest.[4] To this hypothesis Bohr has given the name the Principle of Mechanical Transformability. Numerous examples of the application of this principle might be cited, but the one that concerns us most here is that which deals with the effect of the establishment of a magnetic field on the electronic orbits in atoms. It is well known that Larmor has shown that one result of the establishment of such a field is to endow an

[2] Gerlach and Schutz, *Die Naturwissenschaften*, vol. 11, Heft 28, p. 638, 1923.

[3] Wood and Ellett, *Proc. Roy. Soc.*, A, June, 1923, p. 396.

[4] Ehrenfest, *Die Naturwissenschaften*, vol. 11, Heft 27, July 6, 1923, p. 543.

electronic orbit with a uniform rotation about the direction of the magnetic field, the angular velocity being given by

$$\omega = \frac{1}{2}\frac{e}{m}\frac{H}{c}.$$

Langevin has also pointed out that the size and form of the electronic orbit remain unaffected by the magnetic field. Ehrenfest's hypothesis asserts that if the magnetic field be established slowly the energy of the electron in its orbital motion and the frequency of its revolution in the orbit may be changed, but the *number* of quanta defining its energy undergoes no modification. With the adoption of these principles it is an easy matter to show that when we quantize the angular momentum about the direction of the magnetic field the normal Zeeman components are exactly the same as those provided by the older classical theory of Lorentz. The singular beauty and simplicity of this method of explaining the normal Zeeman effect constitute one of the finest achievements placed to the credit of the quantum theory.

Efforts to explain the abnormal Zeeman effect have not as yet met with the same success. Among the contributions made to this subject perhaps that of Heisenberg[5] is the most stimulating and suggestive. In addition to offering an explanation of the abnormal Zeeman effect it constitutes an attempt to account for the doublet and triplet structure of series spectra.

Taking for example the case of an alkali element, Heisenberg postulates that through magnetic coupling a movement of rotation within an atom of those elements involves simultaneously the valency electron and the core of the atom as well. According to the theory it is supposed that in the various stationary states there is a partition of the angular momentum between the two, one half an azimuthal quantum being assigned to the core and $k - \frac{1}{2}$ azimuthal quanta to the electron. The author supposes further that through space quantization the two axes of rotation are in the same direction, and that the rotation of the core and that of the electron may take place either in the same sense or in opposite senses. As far as the radial quanta for the electronic orbits are concerned, it is assumed that they are given by $n' + \frac{1}{2}$ where n' has integral values. This device leads to the result that the total quantum number characterizing the orbit of the electron is an integer n that is equal to the sum $k + n'$. In this way the author is enabled, at the same time, to characterize the spectral terms in the Rydberg series formulae by integral quantum numbers.

This scheme, it will be noted, provides for the binding of the valency electron in one or other of two energy levels and reduces the frequency difference characterizing the members of the doublet series of the spectra of the alkali elements to a manifestation of what is practically a Zeeman effect produced by an internal atomic magnetic field. To account for the triplet structure of series spectra such as we obtain with the alkaline earth elements, Heisenberg supposes the magnetic coupling to involve not only the core of the atom but the two outer valency electrons as well. It is shown when the theory is extended to take account of an external magnetic field in addition to the internal one, that the Zeeman separations of the magnetic components of doublet and triplet lines are in exact agreement with the laws formulated by Preston and Runge.

When the external magnetic field is high compared with the internal one, the theory shows that for doublets and triplets the final result is a normal Zeeman triplet in complete accordance with the observations of Paschen and Back.[6]

To illustrate the validity of the theory Heisenberg used his formulae to evaluate the magnitude of the internal magnetic field of the atoms of lithium, and found that it led to a value of 0.32 cm^{-1} for the frequency difference characterizing the doublets of the second subordinate series in the spectrum of this element. As the experimental value found by Kent[7] is 0.34 cm^{-1}, it will be seen that the agreement is good.

Again, in connection with the matter of triplet series the theory shows that in the case of the p terms the ratio of the triplet frequency differences should be as 2 : 1, for the d terms it should be as 3 : 2, and for the f terms as 4 : 3. These deductions find ample verification in the measurements made on the frequency differences of triplet series in the spectra of such elements, as magnesium, calcium, strontium, barium, zinc and cadmium.

To say the least, the theory outlined above is extremely suggestive. It leads, however, to rather surprising results. If we are to account for doublet separations generally as being due to Zeeman separations produced by intra-atomic magnetic fields, it follows that with some atoms these must be exceedingly high. Taking the doublet separations of the second subordinate series in the spectra of the alkali elements, we find the following values for the internal magnetic fields of the different atoms:

Element	$\Delta\nu_p$	H_i
Lithium	0.34 cm^{-1}	7,173 Gauss
Sodium	17.18 "	366,744 "
Potassium	57.71 "	1,231,945 "
Rubidium	237.6 "	5,072,090 "
Caesium	554.0 "	11,826,330 "

[5] Heisenberg, *Zeit. für Phys.*, No. 8, p. 257 and p. 273, 1922.

[6] Paschen and Back, *Ann. der Phys.*, vol. 39, p. 897, 1912; vol. 40, p. 960, 1913.

[7] Kent, *Ast. Phys. Jl.*, vol. 40, p. 343, 1914.

If it should turn out that magnetic fields so high as those given above are present in atoms of elements such as those in the alkali group, the results obtained by Wood and Ellett would be easily explained.

Whether the existence of a magnetic coupling between the valency electron and the atomic core justifies Heisenberg in adopting the artifice of partitioning the quanta of rotation between the electron and the atomic core is a debatable point.

It does not appear to be permissible to adopt the value ½ for the azimuthal quantum number in defining the stationary orbits of a heavy atom such as that of uranium. In a recent paper by Rosseland,[8] in which a suggestion is put forward that the phenomenon of radioactivity exhibited by the heavier atoms may be due to some interaction between the nuclear and the external electrons in these atoms, he finds that the nearest approach of an electron to the nucleus in the atom of uranium according to Bohr's scheme of orbits is 16×10^{-12} cm. If the electronic orbit closest to the nucleus in the atom of uranium had ½ for the value of its azimuthal quantum number, it would mean that the shortest distance of approach to the nucleus would be equal to 4×10^{-12} cm. As the radius of the nucleus of the atom of uranium has been shown to be 6.5×10^{-12} cm. it is evident that such an orbit could not exist. For reasons of this character we are practically precluded from assigning to k, the azimuthal quantum number, a value less than 1 in defining the electronic orbits in atoms.

In this paper an attempt has been made to outline some of the leading features of the quantum theory as it is being used to solve the problems of atomic structure as well as of those connected with the origin of radiations emitted by atoms. Other illustrations of special interest might have been drawn from the treatment of problems that have arisen in a study of band spectra[9] and of fluorescence phenomena.[10] The recent work of Cabrera,[11] Epstein[12] and Dauvillier,[13] on paramagnetism, too, has a most interesting connection with the development of inner systems of electronic orbits in atoms in Bohr's scheme of the genesis of atoms.

I venture to think, however, that the few illustrations presented may serve, in a measure, to indicate the power and also the beauty of the methods being put forward to elucidate the problem of the origin of radiation.

J. C. McLennan
University of Toronto

8 Rosseland, *Nature*, March 17, p. 357, 1923.

9 Kratzer, *Die Naturwissenschaften*, vol. 11, Heft 27, p. 577, 1923.

10 Franck and Pringsheim, *Die Naturwissenschaften*, Heft 27, vol. 11, July 6, p. 559, 1923.

11 Cabrera, *Jl. de Phys.*, t. 6, p. 443, 1922.

12 Epstein, Science, vol. lvii, No. 1479, p. 532, 1923.

13 Dauvillier, *C.R.*, June 18, p. 1802, 1923.

BY-PRODUCT VALUES IN THE STUDY OF QUANTITATIVE ANALYSIS[1]

Many of the friends of chemistry as well as some of chemistry's devotees, chemists in the making, do not completely appreciate the value of the study of quantitative analysis because they do not realize the tremendously important rôle which quantitative analysis plays in an industrious world and because some of the worth of its study is in the form of intangible values difficult to analyze and evaluate. Quantitative analysis may be regarded by the student as a meat and potatoes course. After his appetite has been whetted for it by preliminary general and qualitative courses, it forms the "pièce de résistance" of a college chemical education, but leaves room for such hearty side dishes as organic chemistry, physical chemistry, etc., and a light chemical research dessert. But it is meat and potatoes to a young graduate in a very literal sense, for the first position of a large majority of young chemists is in analytical work. Many an ambitious man has used his routine analytical position as a stepping stone to a larger salary in his industry.

The rôle of quantitative analysis in the world's work is truly tremendous. It is absolutely essential to the appraisal of basic raw materials—the different ores and minerals, coal, water, limestone and a host of others. It furnishes the means whereby factory processes are controlled in iron and steel, sulfuric acid, corn products, fertilizer, dye and explosives industries, for example. By it the finished products are analyzed. It is necessary to the enforcement of the federal pure food laws and the state fertilizer and feed laws and it is the backbone of pure and applied chemical research.

Once the student has had the importance of quantitative chemistry pointed out to him and the undoubted help that it will be to him in earning his living some day, he quickly understands part of the benefits of its study. There are, however, other values which the instructor and student both should keep in mind, if full benefit for the latter is to be derived from the analytical courses.

Chief among these are:

(1) Stimulation of the logical mental processes required in thinking through the reasons for the steps necessary in each new method, for figuring out results

1 These undoubtedly also apply to many other laboratory courses as well.

and working problems—similar mental training to that afforded by mathematics.

(2) Training of the memory in the technic of the art. Much of the memory work involved is in learning to make the physical motions necessary adroitly and with fair speed. To achieve this result requires constant effort and much repetition.

(3) Practice in learning how to work. The student should learn not to waste time, to plan his work in advance, and make every minute count to the best advantage. If the courses are well planned he will have to learn this lesson or put in hours of extra work. To turn out work in quantitative analysis is largely a question of planning work in advance. Let the student remember that it is the man who looks ahead who will later have the chance to look behind.

(4) An increase in self-reliance and resourcefulness. When a precipitate appears where it is not expected, the student will not resign in despair but will logically review his steps and figure out in all probability what it must be and govern himself accordingly.

(5) Development of neatness and care in the manipulation of apparatus and in the recording of data and the calculation of results. In the very nature of things neatness and care are prime requisites in quantitative work. The exercise of the constant care and the neat cleanliness which are necessary to accurate analysis strengthens these attributes for use under similar conditions in other fields.

(6) Education in dependability and integrity. Nothing is so dangerous to the success of an analytical chemist as dishonesty in obtaining his results. There are few dishonest analysts in industrial work, for they can not hold their positions. Honesty not only is the best policy, but it is also the best sense, for ethical values are recognized by all educated men. Let the analyst remember that he is a scientist and that in common with all scientists his motto should be "veritatem quaerere," to seek the truth. It is what it is and not necessarily what he thinks it should be.

(7) Encouragement of the use of scientific methods in finding out realities, in discovering the truth. The methods of quantitative analysis are based on facts and it recognizes the value of conclusions founded on observation. It gives the thinking student a distrust of, even disgust for, conclusions reached by a line of reasoning which is based on assumptions.

(8) Admiration and respect for nature and natural laws. When the instructor rejects a student's erroneous results, thereby necessitating the repetition of an analysis, he explains that the results are wrong because of some error that the student himself introduced and not due to some supernatural agency, that the laws which govern the process are immutable. Admiration and respect for nature and natural laws are indeed among the chief by-products in the study of any pure science.

Quantitative analysis is one of the delectable handmaids of civilization. The student often realizes her worth from a dollars and cents point of view, but he often does not realize that, in wooing the lass for her money alone, he overlooks some of her charms. There are certain lessons she can teach that so enrich the student that in later years he will not have to depend on her money for his living. These are some of the by-product values of quantitative analysis.

WALTER S. FROST
UNIVERSITY OF NEW HAMPSHIRE

THE UNION OF AMERICAN BIOLOGICAL SOCIETIES

THE Union of American Biological Societies was formally organized by a meeting of the Council, composed of representatives of the various societies composing the Union, in Washington on April 26 last. The constituent societies were represented as follows:

American Association for the Advancement of Science:
At large, B. E. Livingston, Henry B. Ward.
Section F, Herbert Osborn.
Section G, C. O. Appleman.
Section N, C. A. Kofoid.
Section O, R. W. Thatcher.
American Association of Anatomists: Henry H. Donaldson, G. L. Streeter.
American Association of Economic Entomologists: A. L. Quaintance, William Moore.
American Dairy Science Association: C. W. Larson.
American Genetic Association: G. N. Collins, Sewall Wright.
American Physiological Society: C. W. Greene (A. J. Carlson also appointed, but not present).
American Phytopathological Society: Donald Reddick, C. L. Shear.
American Society of Agronomy: Firman E. Bear, R. W. Thatcher.
American Society for Horticultural Science: C. P. Close, J. H. Gourley.
American Society of Naturalists: H. S. Jennings, A. Franklin Shull.
American Society of Zoologists: W. C. Allee, F. R. Lillie.
Botanical Society of America: B. M. Duggar, J. R. Schramm.
Ecological Society of America: C. C. Adams, R. F. Griggs.
Entomological Society of America: A. N. Caudell, A. G. Böving.
Society of American Foresters: I. W. Bailey, W. N. Sparhawk.

The following were also present:

Representing the Temporary Executive Committee of the Union: I. F. Lewis, C. E. McClung.
By invitation: L. A. Rogers, R. J. Haskell.

The following By-Laws were adopted:

1. *Officers.* The officers of the Council shall be a president, secretary, and treasurer. The president and secretary shall be members of the Council. The treasurer shall be a member of one of the constituent societies of the Union.
2. *Tenure of office.* The president and secretary shall take office after the close of the annual meeting of the Council at which they are elected, and serve until the close of the next annual meeting, except that the officers elected at the first meeting of the Council shall serve at that meeting also. The treasurer shall be elected for three years.
3. *Executive committee.* The executive committee of the Council shall consist of the president and secretary and three other members to be chosen by ballot at the annual meeting of the Council.
4. *Vacancies.* Vacancies in the offices or in the executive committee shall be filled by the executive committee.
5. *Duties.* The duties of the officers shall be those usually pertaining to their respective offices. The duties of the executive committee shall be to carry forward all projects referred to it by the Council; to recommend new projects to the Council; to review projects proposed by members of the Union and make recommendations to the Council concerning them; to consider and recommend additional societies for membership in the Union; to nominate committees; to fill vacancies in the offices or committees; to determine times and places of meeting of the Council and of the executive committee; to prepare the annual report of the Council; and to perform such other functions as the Council may direct.
6. *Committees.* The executive committee shall appoint a committee on bibliography and publication and such other committees as the Council may direct.
7. *Relation to other organizations.* The Council shall take cognizance of the work of the National Research Council, the American Association for the Advancement of Science, and other similar organizations, with a view to cooperation and avoidance of unnecessary duplication of effort.
8. *New members.* Upon recommendation of the executive committee, the Council may admit additional societies to membership in the Union, and determine their representation in the Council.
9. *Finances.* The Council shall have power to receive and administer funds for the promotion of the purposes of the Union. Investments shall be made by the treasurer with the advice and consent of the executive committee. For the defraying of current expenses, the Council shall recommend assessments upon the member societies, to be distributed in such manner as the Council shall determine.
10. *Meetings.* The Council shall meet annually at such time and place as the executive committee shall determine and at other times on call of the executive committee.
11. *Amendments.* These by-laws may be amended at any regularly called meeting of the Council by a majority of those present and voting, provided notice of the proposal to amend, together with a copy of the proposed amendment, is mailed by the secretary to each member of the Council at least two weeks in advance of the meeting.

The report of the Committee on Bibliography and Publication, appointed on April 23, 1922, in conjunction with the National Research Council, was presented by the Chairman, J. R. Schramm. The recommendations of the Committee were adopted, and the Committee was instructed to prepare for publication a report of its work.

It was moved and carried that an American Commission on Zoological Nomenclature, to cooperate with the International Commission, be appointed in consultation with the societies most interested.

In connection with the annual meetings of the societies, the executive committee was instructed to appoint a coordinating committee to arrange the meetings of the various societies with as little conflict as possible.

Officers were elected as follows: President, C. E. McClung; Secretary, I. F. Lewis; Treasurer, A. L Quaintance; additional members of Executive Committee, E. W. Allen, C. W. Greene, and C. A. Kofoid.

I. F. Lewis,
Secretary

SCIENTIFIC EVENTS

COOPERATION IN SCIENTIFIC WORK

A plenary session of the International Commission on Intellectual Cooperation, instituted by the assembly of the League of Nations, has been held at Geneva under the presidency of Professor Bergson. According to a report in the *Journal of the American Medical Association*, the commission approved the action of its subcommittee on bibliography recommending, in view of the impossibility of establishing at the present time a complete international library, the coordination of libraries already existing in the principal centers. The subcommittee recommended also the publication of a bibliographic index and conferences of experts on analytic bibliography to coordinate the work of reviewers and existing libraries, and thus prevent duplication of effort.

The commission decided to transmit to the Council and to the Assembly of the League of Nations a draft agreement for the protection of property rights in scientific work, as elaborated by Professor Ruffini, of Turin, formerly minister of public instruction in Italy. The request is made that the several governments establish protection for authors of scientific discoveries analogous to that accorded by law to the artist and the author. The establishment of an inter-

national agreement for the protection of scientific property rights would result in the creation of a new international league, which would rank with the two leagues now existing, the one for the protection of industrial rights and the other for the protection of artistic and literary property. Ruffini, in modeling his draft agreement, made use of the two French drafts, that of the French Confederation of Intellectual Workers (*The Journal*, May 19, 1923, p. 1467) and that submitted to the French parliament by M. Joseph Barthélémy, deputy from the department of Gers and professor in the law department of the University of Paris.

The Commission on Intellectual Cooperation adopted the following resolutions for promoting mutual aid in intellectual work:

1. The commission warmly approves the creation of national commissions on intellectual cooperation, such as have been established in the countries of central and eastern Europe.

2. The commission invites national commissions already created, and those that may be established later, to appoint delegates to meet with it to consider the best means of organizing mutual aid in intellectual work.

3. The commission begs the Council to request governments that are members of the League of Nations to lend moral and financial support to the endeavors of the national commissions.

4. The commission begs authority from the Council to accept donations from institutions that manifest an interest in its endeavors, such funds to be placed at the disposal of the national commissions.

Various reports on the present conditions of intellectual work in the several countries were presented to the commission. M. de Reynold, professor at the University of Bern, after investigating conditions in Switzerland, Germany, Holland, the Scandinavian countries and Luxemburg, and among Russian emigrants, has reached the conclusion that intellectual life is suffering even in countries that remained neutral during the war. This is due, on the one hand, to the economic crisis, and, on the other hand, to the indifference of governments and people, especially of the younger generation, to the needs of science and art. M. Castella, who was chosen to make a special inquiry in Switzerland, declared that in that country an undermining of cultural studies is taking place; students are becoming more and more utilitarian. M. Luchaire, who took charge of the inquiry among the Latin races of Europe, also testifies to a falling off of interest in intellectual work that promises no immediate practical return.

THE AUSTRALASIAN CONGRESS OF THE BRITISH MEDICAL ASSOCIATION

We learn from *The British Medical Journal* that the Australasian Medical Congress—the first to be held under the direction of the federal committee of the British Medical Association in Australia—will open in Melbourne on November 12; it will meet under the presidency of Mr. G. A. Syme, and the parent association will be fitly represented by Sir William Macewen, F.R.S., the distinguished regius professor of surgery in the University of Glasgow, and president of the British Medical Association last year. He is expected to arrive in Sydney about October 17, by the mail boat from San Francisco, and will be the guest of Sir Walter Davidson, Governor of New South Wales. He will be entertained at dinner by the members of the Glasgow University Club on October 22, and by the New South Wales Branch on October 24. In Melbourne he will be the guest of the governor of Victoria, Lord Stradbroke, and afterwards of Lord Forster, the governor-general of the commonwealth. The arrangements for the congress are now far advanced, and everything is said to give promise of a most successful gathering. There will be twelve sections, the presidents being selected from the various states of Australia and from New Zealand. An exhibition of trade products, including medical and surgical instruments, books, drugs, foods and other articles of direct interest to the medical profession will be held in the new anatomy department of the University of Melbourne during the congress. This new department, the erection of which was begun in January, 1922, will be very complete. It will have two dissecting rooms, each capable of accommodating 300 students, a well equipped museum and a large theater. It will also provide a histological laboratory to accommodate 250 students, and special rooms for operative surgery, neurology and physical anthropology. It is hoped that Sir William Macewen will accept the invitation of the University Council to take part in the opening ceremony during the congress.

THE RESEARCH COUNCIL OF THE STATE COLLEGE OF WASHINGTON

At the State College of Washington during the past year there was organized a research group known as the Research Council of the State College of Washington. Dr. Victor Burke was elected president and H. J. Dana, secretary.

The object of the organization is to stimulate research among the non-agricultural members of the faculty. The membership qualifications are similar to those of Sigma Xi, active membership being restricted to those members of the faculty (not connected with the College of Agriculture) who have made contributions to knowledge. Associate membership is open to those showing an active interest in research and who give promise of later achievement. It is the policy to favor the election of promising

students to associate membership. It is believed that election to membership and resultant association with active research workers will have a stimulating effect upon the students.

The activities of the local research council are patterned after those of the National Research Council and consist in holding open meetings at which the results of original investigations are presented and in holding business meetings to devise ways and means of stimulating research at the college. The results of the first year's activity are very encouraging.

The policy of the Sigma Xi has been to refuse the granting of chapters to state colleges. The need of an organization serving the same purposes as the Sigma Xi is keenly felt by Sigma Xi members serving on state college faculties. The Research Council of the State College of Washington serves the same function as a chapter of the Sigma Xi. The membership requirements are the same and the activities broader and believed to be more effective in stimulating research.

It is believed that the organization of similar groups at other state colleges should be encouraged. A copy of the Constitution of the local group can be obtained by writing to the undersigned.

VICTOR BURKE

COLLEGE STATION,
PULLMAN, WASHINGTON

THE SOCIAL AND ECONOMIC SCIENCES AT CINCINNATI

THE program of Section K, American Association for the Advancement of Science, for the Cincinnati Meeting, from December 27 to January 2, will chiefly concern itself with matters illustrating social and economic progress since the war. The following is a tentative announcement of the program, which will probably be somewhat enlarged before adopted in final form:

Morning Session, December 27

A plea for business strategy in national and international policy: DR. JOHN FRANKLIN CROWELL.

Development of transportation by air: PROFESSOR EDWARD P. MAURER.

Potash resources in the Panhandle of Texas: CHARLES M. DABNEY.

Afternoon Session, December 27

A declaration of principles in labor relations: RICHARD F. GRANT, president of the Cleveland Chamber of Commerce.

Labor relations in printing industry: FRANCIS H. BIRD.

Progress in business integrity: RUDOLPH M. BINDER.

Progress in the development of man power since the war: HUGO DIEMER.

Morning Session, December 28

Group insurance: WM. J. GRAHAM.

Share of insurance in the prosperity of the country since the war: JAMES E. ELSTON.

Progress in life insurance: GENEVIEVE M. CARR.

Progress and science of community fellowship: CHARLES H. PENNOYER.

Afternoon Session, December 28

Railways under the transportation act: H. T. NEWCOMB.

Economic aspects of the forestry situation in Canada: DR. C. D. HOWE.

The development of the nation's hidden vital resources: PROFESSOR HENRY P. SHEARMAN.

Economic problems in the home: LOUISE STANLEY.

Morning Session, December 29

Progress in methods of inquiry and research in the social and economic sciences: PROFESSOR F. STUART CHAPIN.

The economic value of scenic national parks and historical sites: DR. GEO. F. KUNZ.

World commerce as a scientific discipline: DR. JOHN FRANKLIN CROWELL.

The increased use of metric weights and measures: HOWARD RICHARDS.

Will profit sharing bring management sharing? DR. JOSEPH MAYER.

Germany's economic reconstruction: DR. FREDERICK L. HOFFMAN.

F. L. HOFFMAN,
Secretary

AMERICAN ORNITHOLOGISTS' UNION

THE forty-first stated meeting of the American Ornithologists' Union will convene in Cambridge, Mass., from October 9 to 11.

The public meetings will be held in the lecture hall of the Museum of Comparative Zoology, from 9.30 A. M. until 4.30 P. M. each day.

On Tuesday evening, October 9, at 8 o'clock, the members and their guests are cordially invited to meet at the Boston Society of Natural History, 234 Berkeley St., corner Boylston St., Boston, for a social evening with an illustrated lecture of general interest.

On Wednesday evening, October 10, the annual dinner will be held.

On Friday, October 12, there will be the following field trips: (1) To Cohasset, south of Boston, where there will be opportunity to visit several bird-banding stations and to observe the offshore migration of Scoters; (2) To Plum Island, north of Boston, an area of salt-marsh, sand-dunes and beach especially favorable for migrating birds of many kinds at this time of year.

The headquarters of the union will be at the Cop-

ley Square Hotel, Huntington Avenue and Exeter St., Boston.

Members expecting to be present are requested to notify the chairman of the committee, George C. Deane, 80 Sparks St., Cambridge, in advance of the meeting in order to facilitate final arrangements.

SCIENTIFIC NOTES AND NEWS

MAJOR GENERAL SIR DAVID BRUCE, distinguished for his work on tropical diseases, has been elected president of the British Association for the Advancement of Science for the Toronto meeting.

THE honorary degree of doctor of science was conferred by the University of Liverpool during the recent meeting of the British Association on Sir Ernest Rutherford, president; Dr. Ernest Howard Griffiths, general treasurer; Professor Niels Bohr, professor of physics, University of Copenhagen; Professor G. N. Lewis, professor of chemistry, University of California; Professor G. Elliot Smith, professor of anatomy, University of London; Dr. Johs. Schmidt, director, Carlsberg Laboratory, Copenhagen, and Professor J. C. McLennan, professor of physics, University of Toronto.

IN honor of the completion of forty years of service by Dr. Edgar Henry Summerfield Bailey as professor of chemistry at the University of Kansas, a celebration on September 21 was arranged by the university, the Kansas Academy of Science and the Kansas Section of the American Chemical Society. In addition to a dinner in the evening there were in the afternoon addresses by two of Dr. Bailey's former students—Dr. E. C. Franklin, of Stanford University, president of the American Chemical Society, and Professor E. V. McCollum, of the Johns Hopkins University.

DR. HERMANN THOMS, director of the Pharmaceutical Institute of the University of Berlin, has passed through the United States on his way to Japan where he will give lectures as the guest of his former Japanese students. Dr. Thoms has been elected an honorary member to the American Pharmaceutical Association.

DR. BOHUSLAV BRAUNER, professor of chemistry in the Bohemian University, Prague, has been elected an honorary foreign member of the French Chemical Society.

PROFESSOR RICCARDO VERSARI, director of the institute of anatomy of the University of Rome, has received the gold medal of the Italian Society of Sciences for a recent work on embryology of the human eye.

H. S. JONES, formerly chief assistant in the Royal Observatory, Greenwich, has been appointed H. M. astronomer at the Cape Observatory to succeed the late Mr. Hough.

DR. G. F. FREEMAN, chief of the division of plant breeding of the Texas Agricultural Experiment Station, has accepted an appointment as director of the recently created Technical Service in the Haitian Department of Agriculture, beginning his work on September 1.

DR. E. G. NOURSE, head of the department of agricultural economics at the Iowa State College, has accepted a position as dean of the Institute of Economics at Washington, D. C. C. L. Benner, assistant professor of agricultural economics, has also accepted an appointment with the same institution.

CARL GEISTER, of the chemistry section of the Iowa Engineering Experiment Station, has been appointed to a fellowship at the Mellon Institute. The fellowship is one which the Vitrified Tile Floor Association has established at Mellon.

J. C. EVANS, chemical engineer, formerly with the National Bureau of Standards, is now in charge of the cement used in the Wilson Dam at Muscle Shoals, Ala.

GEORGE A. STETSON has resigned his position as assistant professor of mechanical engineering at Yale University and is now engaged in the coal business in Boston.

CALVERT TOWNLEY has been appointed representative of the Federated American Engineering Society and the American Institute of Electrical Engineers on the American committee of the world power conference to be held in London in 1924 in connection with the British Empire Exposition.

DEAN HENRY S. GRAVES, of the School of Forestry of Yale University, has been appointed a permanent member of the New Haven Department of Public Parks.

PRESIDENT A. F. WOODS, of the University of Maryland, acted as official representative of the American Association for the Advancement of Science at the World's Dairy Congress, held in Washington, D. C., on October 2 and 3.

DR. STEPHEN A. DOUGLASS, head of the tuberculosis branch of the National Military Home Hospital, Dayton, Ohio, has been offered the clinical directorship of the Millbank Memorial Fund, which was established to conduct clinics in various localities in an effort to lower the death rate in the United States. Clinic centers will be established in Cattaraugus County, N. Y., in Syracuse, N. Y., and the Bronx, New York. Between $300,000 and $400,000 will be

spent annually for at least five years, under the administration of a board of trustees.

A COMMITTEE of eleven members has been appointed by the American Institute of Chemical Engineers to investigate the problems of corrosion. It is composed of four producers: W. H. Bassett, American Brass Co.; J. P. Hubbell, New Jersey Zinc Co.; P. D. Merica, International Nickel Co.; D. W. Thompson, National Lead Co., and of seven non-producers: W. S. Calcott, E. I. du Pont de Nemours & Co.; W. M. Corse, National Research Council; J. V. N. Dorr, Dorr Co.; R. T. Haslam, M.I.T.; E. C. Lathrop, S. S. Sadtler Co.; A. E. Marshall, consulting chemist, and W. D. Richardson, Swift Co.

DR. H. FOSTER BAIN, director of the United States Bureau of Mines, has resumed his work in Washington after an absence of more than two months, during which he assisted the Department of Commerce in its inquiry into nitrate export conditions in Chile.

O. F. COOK, of the Bureau of Plant Industry, and a party of botanists, including William R. Maxon, of the National Museum, recently returned from Central America and the West Indies, where they have been investigating the sources of crude rubber with the purpose of increasing its production in tropical America. Several weeks were spent in Panama, Costa Rica, Nicaragua and Haiti.

PROFESSOR CARL VOEGTLIN, of the Hygienic Laboratory, U. S. Public Health Service, has returned from Europe where he attended a conference on biological standardization of the Health Committee of the League of Nations. He also attended the International Congress of Physiology and visited various scientific institutions.

D. R. HOAGLAND, associate professor of plant nutrition, of the University of California, and W. Metcalf, associate professor of forestry, have been given a year's sabbatical leave of absence for foreign travel and study.

DR. G. DAVIS BUCKNER, research chemist at the Kentucky Agricultural Experiment Station, has returned after a year's study at the Pasteur Institute, Paris, and the Oceanographic Institute at Monaco.

GENERAL LORD LOVAT, chairman of the forest commission of Great Britain, C. E. Legat, chief conservator of forests in South Africa, and Professor R. S. Troup, head of the forestry department of the University of Oxford, who have been attending the British Empire Forestry Conference held in Ottawa from July 25 to September 7, recently visited the U. S. Forest Products Laboratory at Madison, Wisconsin.

THE Canadian Medical Association is arranging for a Lister Oration to be given once every three years. The first of these will be given next year at the annual meeting in Ottawa by Dr. John Stewart, of Halifax. Dr. Stewart was one of Lister's house-surgeons in the early days in Edinburgh.

PROFESSOR GIOVANNI LOPPA, director of the Astronomical Observatory at Collerania, Abruzzi, committed suicide on September 15. He had been suffering from nervous prostration.

DR. NILS BOHR, of the University of Copenhagen, winner of the Nobel Prize in physics for 1922, will lecture at the Carnegie Technology some time in the latter part of November. Other speakers include Dexter S. Kimball, dean of the College of Engineering at Cornell University, for October 23, 24 and 25; Professor Alfred Stansfield, of the department of metallurgical engineering at McGill University, Montreal, Canada, who will lecture during the period between January 14 and 19.

THE following public lectures are being given this fall at the Brooklyn Botanic Garden:

October 5. The life of the plant. ARTHUR HARMOUNT GRAVES, curator of public instruction, Brooklyn Botanic Garden.

October 19. Bulbs and their allies. HUGH FINDLAY, assistant professor of agriculture, Columbia University.

October 26. The evolution of flowers. ALFRED GUNDERSEN, associate curator of plants, Brooklyn Botanic Garden.

November 2. Ten years of garden work with Brooklyn boys and girls. ELLEN EDDY SHAW, curator of elementary instruction, Brooklyn Botanic Garden.

THE sum of $1,500 has been placed at the disposal of the College of Agriculture of the University of Wisconsin by the Sewerage Commission of the City of Milwaukee for the establishment of a fellowship to study the best methods of using activated sludge as a fertilizer. This material is prepared in large quantities as a by-product in the disposal of Milwaukee sewerage. O. J. Noer has been appointed to the fellowship, which will be under the jurisdiction of the soils department.

THE National Research Council has a fellowship fund provided by The American Seed Trade Association. The total fund available is $2,000 per year. Of this $1,500 to $1,700 will be for the fellow's salary and the rest for traveling and other expenses. The problem to be investigated is the field value of hard seeds of clovers and alfalfas. The fellowship will be located at a large agricultural institution in a region where the problem is important economically. Applications for this fellowship and references may be sent to William Crocker, The Thompson Institute for Plant Research, Yonkers, N. Y.

AN arrangement has been made by which the American Institute of Chemical Engineers and the Institution of Chemical Engineers in the United Kingdom are to cooperate in the exchange of all transactions at cost. As a mark of mutual courtesy the roster of the combined societies is to be printed under a single cover.

A DINNER in celebration of the completion of the hundredth year of the *Lancet* will be held in London on November 28. Sir Donald MacAlister, president of the General Medical Council, will take the chair, supported by the president of the Royal Society, the president of the Royal College of Physicians of London, the president of the Royal College of Surgeons of England, the chief medical officer of the Ministry of Health, the president of the Royal Society of Medicine, and the president of the Medical Society of London. Dr. J. W. H. Laing and Mr. H. D. Gillies are acting as honorary secretaries to the dinner committee.

DR. JAMES MOORES BALL, of St. Louis, has presented his collection of ophthalmic specimens to the Army Medical Museum, Washington. The museum was rich in specimens illustrative of other branches of surgery, but was poor in eye specimens. The collection includes a large number of original drawings of external ocular diseases, photographs, pathological preparations of eye diseases, microscopical sections, eye instruments, rare ophthalmic literature, copies of well known ophthalmic atlases, and many portraits of bygone leaders in ophthalmic work. The drawings and pathological specimens have already been installed in the museum.

THE *Journal* of Industrial and Engineering Chemistry writes: "One of the most important recent developments at Carnegie Institute of Technology has been the organization of an advisory board of Pittsburgh business and scientific men to cooperate with the work of the department of mining and metallurgy. C. W. Heppenstall, president of the Heppenstall Forge and Knife Company, has been elected chairman of this board. The immediate function of the advisory board will be to cooperate with the institute in the solution of current problems affecting the work of the Mining and Metallurgy Department. Beginning with the next college year, the Institute of Technology announces that special courses for graduates of liberal arts and technical colleges will be given by the Department of Mining and Metallurgy. The purpose of these courses will be to train young men for jobs in the metallurgical and allied industries leading to positions of managerial, sales and executive capacities. A consistent demand is being made in this and other iron and steel producing districts, for college men, particularly in the non-technical capacities, from the lack of whom this industry has long suffered. The cooperation of the newly organized advisory board has already been provided in preparing the curricula for these courses."

ACCORDING to *The Observatory*, "News has also been received from Australia that the suggested Solar Physics Observatory has been approved, and the appointment of a director is under consideration. This project has been before the world for many years; it dates from before the war, and on the occasion of the visit of the British Association to Australia in 1914 a deputation on the subject received considerable encouragement from the Government. But of course the war put a stop to everything of this kind for a time at any rate. The news recently received is doubly welcome—firstly on the obvious ground that a new observatory will be gained in a very important longitude, and secondly because we may hope that the sanction of the project is an indication that our Australian friends have made good progress in recovering from the disastrous effects of the war. Special congratulations are due to Dr. Duffield for his success in obtaining this government support, which is largely a result of his personal visits to Australia."

THE British Association Table at the Naples Station was occupied by Dr. Cresswell Shearer, F.R.S., from April 10 to June 21, 1923, and he has sent in a report to the committee as follows: "I was engaged on the problem of the respiration of the growing parts of embryos. The main result of my work was a confirmation (by direct manometer measurements) of Child's work on the determination of oxidation-gradients of the embryo, by the susceptibility methods, using cyanide and other chemical agents. I was able to carry the problem a step farther than Child, in that I was able to find the acetone powders of parts of the embryo still retained (in a reduced form) the different (respiratory) relationships they showed in the living embryo, in that an acetone powder of the embryo head had four to six times the oxidation-rate of a similar quantity of powder prepared from the trunk and tail region of the same embryo."

THE first meeting of the National Council of Mental Hygiene of Great Britain, since it became a legally constituted body, was held in London, July 12, with Sir Courtauld Thomson in the chair. Mr. Clifford Beers, founder of the National Committee for Mental Hygiene in the United States, gave an account of the work in America. An international congress of mental hygienists will be held in the United States in 1925.

THE Polish Physical Society was founded in April, 1920, with five branch sections in Warsaw, Cracow,

Lwów, Wilno and Poznan respectively. Professor Ladislas Natanson, of the Jagellonian University of Cracow, was the first president of the society for the period 1920–23, and in the general assembly held in Warsaw in April last, Professor St. Pienkowski was elected president and Professor Natanson vice-president.

A NEW observatory is being built on the new west campus of the University of Iowa. It will contain a five-inch equatorial instrument, the dome for which is being built in the university's engineering shops. One of the best transit instruments is being secured for the transit room.

UNIVERSITY AND EDUCATIONAL NOTES

CORNELL UNIVERSITY reopens with two new buildings ready for occupancy. The Baker Laboratory of Chemistry and the new dairy building of the State College of Agriculture are completed. The laboratory, built and equipped at a cost of about $2,000,000, will not be formally dedicated this fall. The American Chemical Society has arranged to hold its annual fall meeting in Ithaca in October, 1924, and at that time the dedication will take place. The dedication of the dairy building, erected at a cost of $300,000, will be on October 21. The World's Dairy Congress, meeting in Syracuse that week, will move to Ithaca on Saturday and hold its final session there. Governor Alfred E. Smith, of New York, will be one of the principal speakers.

DR. H. J. WEBBER, professor of subtropical horticulture and director of the Citrus Experiment Station, has been appointed acting dean of the College of Agriculture of the University of California.

RICHARD MONTGOMERY FIELD, of Brown University, has been appointed assistant professor of geology at Princeton.

DR. NORMAN MACDOWELL GRIER, of Washington and Jefferson College, has been appointed assistant professor of evolution at Dartmouth College.

DR. F. R. GRIFFITH, JR., instructor in physiology at Harvard University, has been appointed assistant professor of physiology at the University of Buffalo. Mr. J. J. MacDonald, formerly assistant in biology at the Massachusetts Institute of Technology, has been appointed instructor in physiology at the same institution.

WILBUR HOFF, of the Iowa State College, has become head of the chemistry department at Upper Iowa University at Fayette, Iowa.

DR. PAUL KIRKPATRICK, formerly Whiting fellow in physics at the University of California, has taken up a professorship in the department of physics of the University of Hawaii, at Honolulu, T. H. Dr. Kirkpatrick fills the place left vacant by the removal of Dr. Arnold Romberg to the University of Texas.

DISCUSSION AND CORRESPONDENCE

RELIEF FOR RUSSIAN SCIENTISTS: FINAL REPORT

THE two measures of relief for Russian scientists undertaken at my suggestion by American scientific men were finished during the summer, and a brief statement of what has been done in connection with each is due those who responded so promptly and generously to the call for help.

The first measure was that of the collection of a small sum of money to be distributed to Russian university professors and other intellectuals in Berlin exiled from Russia by the Soviet Government. In response to my call for small subscriptions to make up $1,000, the sum of $1,273 was quickly collected and was sent through the American Relief Administration to one of its most capable men in Europe, Mr. Gardner Richardson, who, in connection with a representative in Berlin of the American Y. M. C. A., organized a committee among the Russian exiles by which the investigations into the comparative need of the different members of the exiled group, and the allotment of particular sums, were made under the general supervision of Mr. Richardson and his American colleague.

I have now received a detailed account of the giving out of all of the money, and have been asked by the Russian committee to express to the American contributors to the fund the heartfelt gratitude of the beneficiaries. Among those aided were fourteen professors from various Russian universities and twenty-one other intellectuals. Although the sums allotted to each were necessarily small they have meant, I am assured, the actual saving of some lives as well as the amelioration of the sad lot of others.

The other measure of relief for Russians was on a much larger scale than the one just referred to and very different in kind. It was the measure organized and carried out with the assistance of the National Research Council and the American Relief Administration, by an unofficial committee composed of L. O. Howard, David White, Raphael Zon and myself. This committee, being aware of the fact that all through the war and for a considerable period after it Russian scientific men and organizations were unable to receive foreign scientific publications, undertook to collect American scientific books, journals and papers published since January 1, 1915, by appealing for gifts of such material from publishing houses,

university presses, scientific organizations and individuals, *for distribution among* Russian universities, technical schools and scientific organizations. The American Relief Administration undertook, at its own expense, to receive in New York, warehouse, repack and transport to Russia and finally to distribute there in detail, under the recommendations of a special committee of responsible Russian scientists representing the major universities and societies, all material collected.

This undertaking, resulting in the collection in America and distribution in Russia of over 25,000 pounds of recent American scientific literature, most of it of excellent quality, has now been entirely completed, and a full statement rendered by the American Relief Administration to the American committee of the exact distribution of every piece of scientific literature. A host of grateful acknowledgments from the beneficiaries to the donors of the material, as well as to the American committee and the American Relief Administration, have been received and are a pleasing testimonial to American sympathy and generosity. Many of these acknowledgments express two hopes: first, that more American scientific literature can be received, and, second, that the Russian organizations may soon be in position to send their own publications in exchange for those received. However, as the American Relief Administration has now completed its work in Russia and has withdrawn all of its personnel, and as the mails are now open to private sendings to and from Russia, and the Smithsonian Institution's Bureau of International Exchange is now functioning again as regards Russia, the committee will not undertake further service.

The American Committee, in closing its labors, wishes to express its own warm thanks, in addition to those it has been asked to express on behalf of the Russian beneficiaries, to those many scientific organizations and men who generously participated in this unusual relief undertaking. I wish also to add my personal thanks to SCIENCE for the use of its columns in making the appeals necessary for these attempts to aid Russian scientific men in their period of distress.

VERNON KELLOGG

NATIONAL RESEARCH COUNCIL

ENTOMOLOGICAL ILLUSTRATIONS

IN the course of a review in a recent number of SCIENCE Dr. A. D. MacGillivray[1] takes the opportunity to comment adversely upon a certain type of illustration that is now being used to some extent by entomologists. I am not especially concerned with his remarks as they apply to the particular paper reviewed, but as they are intended to apply to entomological illustrating in general I happen to be somewhat interested.

Says Dr. MacGillivray,

> Figures where one half shows the dorsal surface and the other half the ventral surface are being produced by many authors. This is to be deplored because such figures never give the perspective of the insect as a whole that can be secured from complete figures of each surface, while there is always confusion and doubt as to the accuracy of the structures located on and near the meson, and [he adds with an insouciance worthy of a congressman] so long as the government is financing the project, the question of expense should not be a serious one.

Now I have perhaps used this type of illustration as much as any one, for I count something over 300 published figures of this sort for which I am responsible. Furthermore, I have induced my students to use it also, and I am inclined to believe that it will eventually be recognized as a standard method in entomological work. Consequently, I feel impelled to rise to its defense.

If any other excuse for this reply be considered necessary it may be found in my belief that the matter of the proper type of illustrations to accompany our systematic work in entomology, at least, merits the most serious consideration. I am committed to the belief that the willingness and the ability to produce figures, or the possession of such financial support as is necessary to have them produced, is a part of the necessary equipment of any systematist who wishes his work to endure. The character of these figures is a most important matter.

Dr. MacGillivray's use of the word "perspective" is somewhat peculiar, for of perspective as it is understood by artists these figures in question contain none whatever. I take it that he means the general shape and appearance of the insect and this being the case I am unable to see that his objection has any force. As a matter of fact it is just as easy to gain a sufficiently clear conception of the general form from these drawings as from any other after one has become accustomed to them. Such a drawing, like a topographical map, requires a certain amount of interpretation but is none the less usable.

The objection that confusion may arise as to the exact character of structures on the meson has some slight foundation, but Dr. MacGillivray's sweeping statement that there is "always" doubt concerning them is a trifle too all-inclusive. My experience with these figures has extended through such diverse groups as the Anoplura, Mallophaga, Coccidae, Aphidae, Psyllidae, Hippoboscidae, Streblidae and Nycteribiidae, and I have yet to find a case where the obscuring of structures on the median line is of any very great importance. In a few cases where there is

[1] MacGillivray, A. D., "The Maskell collection of coccidae," SCIENCE, LVII, 734, 1923.

a longitudinal median sulcus which coincides with the line separating the two halves of the drawing there may be some trouble. In other cases of median structures, such as setae, there are very obvious ways of avoiding the difficulty.

I am aware that in addition to these objections there is the further one that these drawings are the source of acute mental pain to some because of their "inartistic" appearance. This is a purely subjective difficulty that arises from a very common misconception of the purpose of a scientific illustration. A scientific illustration is not intended merely as a pretty picture and it has nothing to do with art. Its purpose is merely to present in the simplest and most accurate manner the things that it is desired to show and its production involves nothing more than good draftsmanship. If in addition to these qualifications it is also artistic—whatever that may mean—so much the better. But I can point to many entomological illustrations that have completely lost their scientific value in the often labored strivings of their makers to be artistic.

The advantages of these divided drawings are several. In the first place there is the very great saving in the cost of the blocks. Obviously, the presentation of full drawings of each side of an insect would cost just twice what these divided figures cost. I am inclined to believe that no one will disagree with me when I remark that this is not an unimportant factor. In the second place, there is the saving in the time of making the drawings, a saving that amounts to at least one third. I doubt if any one who has not himself undertaken the production of the figures to accompany an extended paper appreciates what this means. There is also the saving of space in printing. There is the convenience of having the two sides of an object so figured that they may readily be compared. Such advantages seem greatly to outweigh any objections that I have thus far seen urged against these figures.

G. F. FERRIS

STANFORD UNIVERSITY

FOREST DISTRIBUTION IN THE NORTHERN ROCKY MOUNTAINS

J. E. KIRKWOOD, professor of botany in the State University of Montana, has written a book on the "Forest Distribution in the Northern Rocky Mountains," which has appeared as Bulletin No. 247, State University Studies Series No. 2, Missoula, Montana, 1922. It is illustrated with 45 figures, some of which are photographs of forest scenery, some of them are graphs of precipitation, temperature and general humidity, while some are maps and profiles of topography. After an introduction in which the principal collections and the botanical collectors are mentioned, the author describes the topography of Montana and its climate (with tables and diagrams).

In tracing the sources of the vegetation, Professor Kirkwood refers to the rich flora of the Tertiary Period in giving the past history of the plant life of the region with lists of the principal genera. The migrations of the present day species into the northern Rocky Mountains is considered with some fulness. The author describes the northern element which appears to have moved southward along the Rocky Mountains into Montana. The eastern contingent includes a number of trees and shrubs. The western element he believes is the most conspicuous in the forest flora of the mountainous region, and he gives a list of species which have entered from the west, or northwest. Other details of possible migration are included.

Chapter IV deals with the General Forest Aspects where coniferous vegetation is dominant with yellow pine and Douglas spruce as the prevailing trees over the greater part of the region. East of the divide, the forest is more open, and assumes a more xerophytic aspect. In a number of tables the composition of the forests of its different forest sections is given with the range in altitude of each species. Percentage compositions are included. The forest zones and formations are then presented in some detail. Professor Kirkwood describes the foot hill vegetation, the slide rock succession, the forest of the western valleys, and the forests of the montane, or Canadian belt, where *Pinus contorta*, *P. albicalis*, *Picea Engelmanni* and *Abies lasiocarpa* are the principal species. The subalpine zone of the Montana Rockies (the Hudsonian Zone of Merriam) has a few trees, a limited number of shrubs and herbaceous perennials. The forests are broken into limited tracts by meadows, bogs, lakes, rock fields, snow fields, chasms, etc. A summary and bibliography complete this contribution of 180 pages to forest botany.

JOHN W. HARSHBERGER

UNIVERSITY OF PENNSYLVANIA

QUOTATIONS

SCIENCE AND PUBLICITY

THOUGH the British Association welcomes membership from the general public, it is not too much to say that the presidential addresses, and most of the papers presented to Sections, are intended for audiences of special scientific workers. In the case of a body like the British Medical Association, membership is limited to professionally qualified men, and in the Sections, therefore, no attempt need be made to deal with scientific subjects in popular terms. With its

mixed membership, however, the British Association is in a different—and also more difficult—position. Interpreters are needed, if not in the Section rooms themselves, then in the public press. Leading newspapers prefer that their own correspondents or contributors should perform this function, but there are many others which would gladly make use of notes and articles on scientific subjects suitable for the general reading public.

In the United States an institution entitled "Science Service" was established a year or so ago to provide such popular articles as a scientific news syndicate, and it now supplies about fifty American newspapers, and several in Canada and other parts of the world, with news Bulletins sent from Washington every day except Sunday. "The first consideration in a Bulletin story," says a circular of instruction to writers of articles, "is to tell of or interpret a scientific event. But the news stories must be so well written that large national newspapers will use them without rewriting or revision, either in form or language. Write your story so that those who know nothing about science will understand and want to read it. Weave in the scientific background that the man in the street does not have. Use simple words. Make your story as graphic as if you were talking about it." It is pointed out, in addition, that "'By Science Service' must stand for accuracy of content and implication."

In order to establish this publicity agency for science, a generous benefactor gave a large sum to a Board of Trustees which includes among its members several of the most distinguished men of science in the United States. The whole field of scientific activity everywhere is covered by "Science Service," and the Bulletins are first-rate examples of what can be done to present scientific progress in popular and yet accurate form. We understand that the demand for the Bulletins from newspapers is now sufficient to make this admirable news agency practically self-supporting.

Here, then, we have an excellent example of what can be done successfully for the popularization of science; and it is obvious that the constitution and methods of such an organization are very different from those of the British Association, though the aims of both are "to promote general interest in science and its applications." We believe that the National Union of Scientific Workers contemplates establishing a similar scientific news agency to that of "Science Service," and a beginning has already been made by the British Science Guild by the issue of Publicity Pamphlets sent to the newspaper press for reproduction in whole or in part without payment. Since January, 1921, the Engineering Foundation of New York has been issuing a series of such "Research Narratives," each containing the story of some research, discovery or notable achievement in science or engineering. In one form or another these narratives have found their way through practically the entire range of the public press in America as well as the technical journals.

It is clear, therefore, that we in the British Isles are much behind the United States in the provision made for publicity for science. Our scientific societies are second to none, and the number and value of papers published by them are higher now than ever they were, yet no adequate agency exists to extend the knowledge of this work beyond scientific circles and thus to create in the public mind a feeling of pride in our scientific achievements. A great opportunity awaits the benefactor who will provide a liberal sum to establish a British science publicity service comparable with what has proved so effective in America. Political, social, religious, temperance, labor and scores of other organizations regard it as a duty to carry on their propaganda by means of leaflets and like publications, but science is content to keep its message to itself. It is no wonder, therefore, that the community understands so little of the value and meaning of science. Let us hope that means will soon be forthcoming to establish a bureau which will not only make the proceedings of annual meetings of the British Association widely known and easily intelligible, but will also, throughout the year, continue to interpret scientific advances to a world eager to learn of them but unacquainted with the technical vocabularies in which they are commonly expressed.—*Nature.*

SCIENTIFIC BOOKS

World Weather, Including a Discussion of the Influence of Variations of Solar Radiation on the Weather and of the Meteorology of the Sun. By HENRY HELM CLAYTON. 8vo. New York, The Macmillan Co., 1923. Pp. XX, 393; Figs. 265; Pls. XV.

"WORLD WEATHER" embodies the results of the author's investigations, study and thought during his association of more than twenty years with the Blue Hill Observatory, and, more recently, during his term of service as chief of the forecast division of the Argentine Meteorological Office. Those who have followed Mr. Clayton's writings throughout this time will see in this volume the careful elaboration and critical analysis of many of the views which he first announced a good many years ago. "World Weather" is far more a discussion of certain selected topics in meteorology than it is a general text-book of that science. In fact, it is not a text-book at all, in the ordinary meaning of that term. It is true that there is a consideration of certain general matters such as

moisture, clouds and rainfall, for example, and of sky colors and the "visible signs of the sky and air," with brief mention of other well-known meteorological phenomena. In the main, however, the plan of the book is quite different from that with which teachers and students of meteorology are familiar.

The fundamental idea, as the title indicates, is world meteorology, and it is the larger aspects of the subject which are stressed. The usual discussions of the composition of the atmosphere; of the ordinary instruments; of isothermal charts; of the characteristics of the surface winds; of the distribution of the mean annual rainfall, etc., are lacking. As we see it, "World Weather" is suited for the use of the teacher and the advanced student of meteorology; of the physicist and astronomer with an interest which reaches somewhat beyond the narrower limits of their own sciences; of the intelligent reader who, knowing something of meteorology, wishes to enlarge his vision by acquaintance with some of the new researches in the mechanism of the atmosphere which promise so much for the future. While much of the book can be read easily and rapidly, there are many parts of it which, in order to be fully understood, need careful study.

The real purpose is to bring out the relations between the variations of solar radiation and terrestrial meteorological conditions as Mr. Clayton sees them, not only in connection with forecasting for a week ahead, which he himself carried on successfully in Argentina, but also in connection with various more or less well established periodicities in weather and solar phenomena. In the introduction the author distinctly states his conviction that the "newer researches . . . indicate that the time is near at hand when weather changes can be anticipated so far in advance as to save much of the loss and distress which now follows in the wake of the unexpected adverse conditions." Mr. Clayton believes that without solar changes "there would result a balanced system of atmospheric changes such that the same conditions would return year after year at the same time of day and at the same time of year." He believes that the irregular changes which we call weather result chiefly, if not entirely, from irregular changes in solar radiation. Not only so. Our author also attributes long-period changes of temperature and of rainfall, occupying several decades or even centuries, at least in part to solar changes. Even glacial epochs may have been due to great increases in solar radiation, which would have intensified tropical rainfall, the oceanic cyclones and the continental anticyclones of high latitudes, thus bringing about lower temperatures over the high latitude land areas.

A detailed explanation is given of the method of forecasting in Argentina on the basis of the observations of solar radiation made by the Astro-Physical Observatory of the Smithsonian Institution in Chile. This method, begun December 12, 1918, originated with Mr. Clayton, and was made possible through the cooperation of the Smithsonian Institution. The field is one which our author has made peculiarly his own, and to it he has devoted a large part of his time during the past few years. It is one of the outstanding developments in the history of weather forecasting. The changes in temperature and in pressure from day to day are believed to have close relation to short-period changes in solar radiation. The monthly means of temperature and pressure are also closely related to the monthly means of solar radiation. Further, year-to-year variations are shown to be connected with year-to-year variations in rainfall and in the height of rivers in North and South America and in Australia. Long-period weather changes are found which correspond with the sunspot period, but these are less marked than the changes of shorter duration. Pressure, rainfall, temperature and other phenomena were investigated at stations all over the world, and oscillations similar to those of the sunspots appear, although the weather conditions are more variable than the sunspots. Sunspot influence shows both an annual and a semi-annual period, but the conditions are far from simple. There is some evidence that snowfall is deeper and icebergs are more numerous at sunspot maximum, and that the Nile and other tropical rivers are highest at sunspot maximum, while rivers like the Parana in temperate regions show an inverse effect.

There are other subjects to which Mr. Clayton makes noteworthy contributions. In regard to the general circulation of the atmosphere our author, after a consideration of the various views which have been advanced during the past fifty years or more, states that Ferrel's theory furnishes the simplest and most plausible explanation yet given of the motions of the atmosphere under the influence of heat and gravity on a rotating body like the earth. This is a very interesting confirmation of the soundness of Ferrel's reasoning, for at the time of his writing very few observations of cloud movements had been made. This view may, however, possibly need modification as further facts become known. The explanation of the essential facts of upper air temperatures in relation to the stratosphere and its height above sea-level is found in the expansion and cooling of the ascending air in equatorial latitudes and in its warming by compression and cooling by radiation as it descends toward the poles on the upper gradients. Regarding the much-discussed question as to the origin of extra-tropical cyclones and anticyclones, Mr. Clayton believes that an explanation is found in contrasts of temperature observed when large bodies of colder air

lie in close proximity to warmer air. The available facts as to temperature, winds and pressures in cyclones and anticyclones are found to be in agreement with the results of computation, so that the statement can be made, "sharp contrasts in temperture in adjacent bodies of air causing steep gradients are fully capable of producing the permanent and wandering cyclones and anticyclones of the atmosphere in temperate regions." Mr. Clayton's views on this matter are different from the recently much-discussed Bjerknes polar front theory, yet there are points of resemblance between the two. Regarding tropical cyclones there is naturally a good deal of doubt, although here also differences of temperature between a central area and the surrounding air are believed to explain the origin.

Other subjects discussed in "World Weather" there is no opportunity to consider here. There are chapters on the physics of the air in relation to solar and terrestrial phenomena; and on the meteorology of the sun, and there are three appendices dealing with mathematical methods of treatment. We regret that, in a book of this character, many of the illustrations are very crude, and a few are so indistinct that they are barely serviceable. Many references are incomplete according to the usual standards in such matters, and occasional references to writers in the text without any indication as to what and where these persons have written are not helpful in a scientific discussion. Misprints are fairly numerous, but in no case are these so glaring that the meaning is obscured. The summaries at the beginning of each chapter are a very useful feature of the book. When so much that is new and necessarily still more or less controversial is presented by an author of Mr. Clayton's standing there is sure to be a more or less animated debate as to the value of the evidence and as to the methods of using it. Into any such critical analysis it is impossible to enter here, nor has the reviewer any desire to do so. It may very likely be that the author himself may see reason to revise and to modify some of his conclusions, and it is almost certain that a good many persons, meteorologists and others, will hesitate to accept them all as they stand. They are by no means all equally convincing. But that the author has taken infinite pains in his laborious and time-consuming investigations is evident on every page, and that he has written a very important chapter in the new world meteorology no one can deny. It is a very inspiring view of the future of meteorology in relation to long-range forecasts, of immense economic importance to man, which Mr. Clayton here gives us.

R. DeC. Ward

Harvard University

SPECIAL ARTICLES

INHERITANCE OF DIRECTION OF COILING IN LIMNAEA

A recent paper by Boycott and Diver (1923, Proc. Roy. Soc., 95 B; 207) on the inheritance of dextral and sinistral coiling in the snail Limnaea suggests that this character may give an exceptionally clear illustration of "maternal" inheritance that is nevertheless dependent upon the chromosomes.

These authors find that if a single individual of Limnaea is isolated at an early stage it will reproduce, presumably by self-fertilization. Broods produced in this way are always either wholly dextral or wholly sinistral (with the rare exceptions noted below)—but either type of parent may produce either type of brood. This result agrees with the findings of Mayor (1902) and Crampton (1916) on the viviparous Tahitian land-snail Partula, where a given individual contains in its brood-pouch only one type of young. A sinistral individual may have either sinistral or dextral young—but never both types at once; and the same is true for a dextral mother.

Boycott and Diver have also mated together two individuals, and have reared from such pairs mixed broods, which they report as giving 3 dextral : 1 sinistral or 1 dextral : 1 sinistral. In the absence of numerical data, and in view of the fact that the eggs from the two parents were not separated in these experiments, one may doubt if these ratios are anything more than fortuitous ones due to the two members of the pairs in question producing different types of offspring. If one does interpret these ratios as merely chance ones, it becomes possible to formulate a much simpler interpretation than the one suggested by these authors.

An analysis of the data presented suggests that the case is a simple Mendelian one, with the dextral character dominant, but with the nature of a given individual determined, not by its own constitution but by that of the unreduced egg from which it arose.

This last assumption becomes extremely plausible when it is recalled that it was shown by Crampton and by Kofoid in 1894 that dextral and sinistral snails can be distinguished at least as early as the second cleavage division (perhaps at the first), since the cleavage-pattern of one is the mirror-image of that of the other. A character that appears so early in development might well be expected to be determined by the genes present in the mother—*i.e.*, in the unreduced egg, rather than by the combination present after reduction and fertilization. Yet the results obtained by Boycott and Diver can not be accounted for unless it is supposed that the sperm does actually

produce an effect, though the effect is delayed for one generation.

The hypothesis here suggested may be made clearer by the following elaboration. Let the recessive gene for the sinistral character be represented by *l*, and its dominant allelomorph for the dextral character by *L*. Then any heterozygote, Ll, will produce by self-fertilization three types of offspring—LL, Ll and ll. Since all the eggs contained the gene L before reduction, all these individuals will be dextral in somatic appearance; but the ll individuals will themselves produce only sinistral offspring. If an ll individual of this family mates, as a female, to an LL, the offspring will all be sinistral (since the mother carried no L); but they will be Ll in constitution and will therefore produce only dextral offspring. Further combinations may easily be worked out.

It is probable that dextral snails can not mate with sinistral ones; this being the case one might expect that heterozygous individuals would quickly disappear from the colonies, in which case no such results as recorded would be obtainable. The paper under discussion gives a clue as to why the heterozygotes do not disappear. In families that were expected to be purely sinistral a dextral individual occasionally appeared. If such individuals are due to some environmental cause and are genetically sinistral, they will of necessity mate with dextrals and produce new families of heterozygotes. This interpretation is borne out by Lang's results with Helix, where the occasional cases of reversed symmetry were found not to be inherited at all.

Further data on the case of Limnaea will be awaited with interest, for it seems likely that we shall have here a model case of the Mendelian inheritance of an extremely "fundamental" character, and a character that is impressed on the egg by the mother.

A. H. Sturtevant
Columbia University

VOICE AS A FACTOR IN THE MATING OF BATRACHIANS[1]

Choruses of frogs and toads form one of the impressive sounds of nature. Nevertheless, little or no significance has been attributed to voice in the mating of batrachians. It is stated not to control the direction of migration towards the breeding grounds, or the movements of individuals on the grounds (Boulenger,[2] Cummins[3]). It is generally believed that "courtship does not take place in any of the tailless batrachians. The female is seized by the first comer, . . ."[4] Some years ago it was pointed out by Courtis[5] and later by Miller[6] that the toad responds to sound readily during the breeding season, and that the female may even be attracted towards the calling male. But Cummins[7] has recently shown that in the case of frog material the "*voice does not direct* the movement of the frogs into the pond" and "that sex 'recognition' . . . results from the differential behavior of the two sexes when clasped, . . ."

During the past season I have studied the problem with tree frog material. Such material is especially favorable because their breeding grounds are generally less crowded than in the case of the other species, and direct observation of individuals is possible. This method of direct observation was unfortunately not employed by Cummins.

The species most thoroughly studied by me was the little-known *Hyla andersonii*. At Lakehurst, N. J., the males begin calling in early May. They call from the ground and generally from concealment. Later in the month they call from the tops of bushes or from trees several feet from the ground. The breeding does not occur simultaneously throughout the region, or even in the same bog. Individual males that were kept under observation by means of flash lamps throughout the night were seen to leave their high calling stations and make their way to nearby sphagnum-choked ditches or to slow-flowing streams in the bog. Each took up an isolated position near one of these basins and began to call again. Females were first discovered making their way across the bog. In three instances their movements were closely followed. They proceeded directly across the marsh, over ditches and puddles toward particular males. In all three cases the calling males paid no attention to the approaching females. In one case the female leaped directly upon the back of the male. He threw her off and continued calling. She leaped on his back again, but again he threw her off. This time, however, he turned and before she could spring again had embraced her. In the second case the female leaped at the calling male but receiving no attention, she circled twice around him, nudging him with her limbs as she endeavored to draw as near to him as possible. In the third case the calling male paid no attention to the female and amplexus did not occur. In the former cases oviposition took place in the adjacent water. Oviposition in *H. andersonii* differs from that of other American species of Hyla, in that the eggs strike the body of the male and are thrown to the bottom of the ditch, where they may or may not adhere to the sphagnum or other vegetation.

1 Summary of a paper read before the Linnaean Society of New York, November 14, 1922.

2 Boulenger, G. A., 1912, *Proc. Zool. Soc. London*, p. 22.

3 Cummins, Harold, 1920, *Jour. Exp. Zool.*, XXX, pp. 325–343.

4 Boulenger, G. A., 1897, "The Tailless Batrachians of Europe," p. 68.

5 Courtis, S. A., 1907, *Amer. Nat.*, XLI, p. 678.

6 Miller, Newton, 1909, *Amer. Nat.*, XLIII, p. 650.

7 *Loc. cit.*, p. 342, italics his.

Later in the season I made a single observation on the Gray Tree Frog, *H. versicolor*, which would tend to prove that in that species, too, the female is attracted by the call of the male. In this instance a female was seen to approach a calling male from behind. The approach was very rapid and the female leaped without hesitation on his back. The male broke off his call at once, turned and embraced the female.

When the movements of individuals of other species have been studied during the breeding season, I believe it will be shown that voice plays a considerable part in bringing the two sexes together. The problem of sex retention is another one, and need not be considered here. Many, perhaps most batrachians in the tropics, breed in isolated pairs. If there were no mechanism for bringing the two sexes together, these frogs and toads would have little chance of breeding.

G. K. NOBLE

THE AMERICAN MUSEUM OF NATURAL HISTORY, NEW YORK CITY

THE MILWAUKEE MEETING OF THE AMERICAN CHEMICAL SOCIETY

THE sixty-sixth general meeting of the American Chemical Society was held in the auditorium, Milwaukee, Wisconsin, Monday, September 10, to Friday, September 14, 1923.

Opening addresses were given by Clare H. Hall, chairman of the Milwaukee Section of the American Chemical Society; Honorable Daniel W. Hoan, mayor of Milwaukee; Honorable Emmanuel Philipp, president Milwaukee Association of Commerce, and Rev. Albert C. Fox, President Marquette University. Dr. E. C. Franklin responded on behalf of the Society.

Two general addresses were the feature of the Tuesday morning session as follows:

Charles F. Burgess, director of the Burgess Laboratories. "Marketing Chemical Discoveries."

Arthur I. Kendall, dean of the Medical School, Northwestern University. "Bacteria and the Chemist."

The previous custom of having general addresses in the afternoon session was abandoned and instead thereof three special meetings of the more fundamental divisions of Physical and Inorganic Chemistry, Organic Chemistry and Chemical Education were held with papers especially selected to meet the needs of all chemists present.

On Tuesday evening a complimentary dinner and entertainment was given to the members and guests by the Milwaukee Section. Approximately one thousand sat down to this dinner. The program consisted of songs, dancing and instrumental music.

On Wednesday at 8 p. m., a reception was held at the Marquette University gymnasium followed by public addresses by Mrs. Thomas G. Winter, president General Federation of Women's Clubs, and the annual address of the president of the society. President Franklin took as his subject, "Systems of Acids, Bases and Salts." Past President Edgar F. Smith presented the Priestley Medal *in absentia* to Professor Ira Remsen.

On Thursday evening group dinners and college reunions were held and the members also attended a very interesting and lively amateur boxing contest at the Milwaukee Athletic Club.

A special program consisting of dinners, automobile drives, etc., was arranged for the ladies and a complimentary dinner was given to the wives of the councilors on Monday evening.

Wednesday and Thursday were otherwise given up wholly to divisional meetings.

The following Divisions and Sections met: Divisions of Agricultural and Food Chemistry, Biological Chemistry, Cellulose Chemistry, Dye Chemistry, Fertilizer Chemistry, Industrial and Engineering Chemistry, Leather Chemistry, Chemistry of Medicinal Products, Organic Chemistry, Petroleum Chemistry, Physical and Inorganic Chemistry, Rubber Chemistry, Sugar Chemistry, Water, Sewage and Sanitation; Sections of Chemical Education, Gas and Fuel Chemistry, and History of Chemistry.

The divisions elected officers as follows:

DIVISION OF AGRICULTURAL AND FOOD CHEMISTRY: *Chairman*, C. H. Bailey; *Vice-chairman*, E. F. Kohman; *Secretary*, C. S. Brinton; *Executive Committee*, G. E. Holm, J. W. Read, R. H. Carr.

DIVISION OF BIOLOGICAL CHEMISTRY: *Chairman*, W. T. Bovie; *Secretary*, R. A. Dutcher.

DIVISION OF CELLULOSE CHEMISTRY: *Chairman*, G. J. Esselen, Jr.; *Vice-chairman*, Louis E. Wise; *Secretary-Treasurer*, L. F. Hawley; *Executive Committee*, The Officers ex-officio and Harold Hibbert, A. W. Scharger.

DIVISION OF DYE CHEMISTRY: *Chairman*, W. J. Hale; *Vice-chairman*, R. E. Rose; *Secretary*, R. Norris Shreve; *Executive Committee*, L. A. Olney, L. F. Johnson.

DIVISION OF FERTILIZER CHEMISTRY: *Chairman*, F. B. Carpenter; *Vice-chairman*, R. N. Brackett; *Secretary*, H. C. Moore; *Executive Committee*, H. J. Wheeler, C. H. Jones, E. W. Magruder and A. J. Patten.

DIVISION OF INDUSTRIAL AND ENGINEERING CHEMISTRY: *Chairman*, D. R. Sperry; *Vice-chairman*, W. A. Peters; *Secretary*, E. M. Billings; *Executive Committee*, W. K. Lewis, C. E. Davis, E. R. Weidlein, C. S. Miner, C. E. Coates.

DIVISION OF LEATHER AND GELATIN CHEMISTRY: *Chairman*, John Arthur Wilson; *Vice-chairman*, F. P. Veitch; *Secretary*, Arthur W. Thomas; *Executive Committee*, I. D. Clarke, L. M. Tolman.

DIVISION OF CHEMISTRY OF MEDICINAL PRODUCTS: *Chairman*, E. H. Volwiler; *Secretary*, H. A. Shonle; *Executive Committee*, E. B. Carter, Frank O. Taylor.

DIVISION OF ORGANIC CHEMISTRY: *Chairman*, R. R. Renshaw; *Secretary*, J. A. Nieuwland.

DIVISION OF PETROLEUM CHEMISTRY: *Chairman*, R. R. Matthows; *Vice-chairman*, R. E. Wilson; *Secretary*, W. A. Gruse; *Executive Committee*, E. W. Dean, W. F. Faragher.

DIVISION OF PHYSICAL AND INORGANIC CHEMISTRY: *Chairman*, Graham Edgar; *Vice-chairman*, Arthur Hill; *Secretary*, H. B. Weiser; *Executive Committee*, R. E. Wilson, G. S. Forbes, A. W. Browne, C. E. Coates, H. Schmidt.

DIVISION OF RUBBER CHEMISTRY: *Chairman*, E. B. Spear; *Vice-chairman*, C. R. Boggs; *Secretary*, A. H. Smith; *Executive Committee*, Winfield Scott, W. B. Wiegand, Ira Williams, L. B. Sebrell, H. B. Pushee.

DIVISION OF SUGAR CHEMISTRY: *Chairman*, F. W. Zerban; *Vice-chairman*, H. W. Dahlberg; *Secretary-Treasurer*, Frederick Bates; *Executive Committee*, C. E. Coates, W. B. Newkirk, J. S. Osborne, H. Z. E. Perkins, M. J. Proffitt, J. R. Withrow.

DIVISION OF WATER, SEWAGE AND SANITATION CHEMISTRY: *Chairman*, W. W. Skinner; *Vice-chairman*, F. W. Mohlman; *Secretary*, F. R. Georgia; *Executive Committee*, A. L. Fales, A. M. Buswell.

Actions taken by the Council included the following:

H. E. Howe, chairman of the committee on Garvan Chemical Prizes for secondary schools, outlined the gift of $10,000 from Mr. and Mrs. Francis P. Garvan and the preliminary work and future plans of the committee. It was voted to adopt the report and to instruct the secretary to express the Society's hearty thanks and appreciation to Mr. and Mrs. Garvan for their splendid gift.

Edgar F. Smith presented a report of his conference with the officials of the Allied Chemical and Dye Corporation regarding the $25,000 prize previously announced.

It was voted to authorize the Section of Chemical Education to form a Division of Chemical Education.

The following new fellowships and continuation of annually awarded fellowships were announced:

The Hammermill Paper Company has given a fellowship of $1,200 to the New York State College of Forestry, to be known as the "Hammermill Fellowship in Pulp and Paper Manufacturing."

The Grasselli Chemical Company has renewed its fellowship for $750 and scholarship for $500 in the Massachusetts Institute of Technology.

The du Pont Company has also renewed its fellowship in the Massachusetts Institute of Technology.

The Public Health Institute of Chicago has renewed its twelve $500 research fellowships in chemistry at Northwestern University, and in order to preserve the time of the fellows for research, the same institute has made an additional annual appropriation of $3,000 for the support of a special laboratory for the preparation of research intermediates not available on the market.

The National Lime Association has awarded a $1,000 fellowship at the Massachusetts Institute of Technology.

The du Ponts, the National Lime Association and the Grasselli Chemical Company have renewed their fellowships at the Ohio State University.

A. F. Gallun and Sons have renewed their annual grant of $5,000 for leather chemistry research to Arthur W. Thomas at Columbia University.

A research fund of $3,600 has been provided for research in plasticity at Lafayette College for 1923–24 by the du Pont Company.

The Palm Olive fellowship of $2,000 on the detergent action of soap has been awarded to Paul H. Fall, who will work under Dr. Bancroft at Cornell University.

The Fleischmann Company has renewed its fellowship at the University of Minnesota.

The Stretmann Biscuit Company, of Cincinnati, Ohio, has given a fellowship of $1,000 to the University of Minnesota for the study of the chemistry involved in the cracker manufacture.

The following resolution presented by Professor E. C. Bingham, chairman of the Metric System Committee, was adopted:

All articles relating to laboratory tests of procedure published in any of the journals of the American Chemical Society shall contain dimensions expressed metrically. Other equivalents may be added where the author so desires.

A. B. Lamb was reelected editor of the *Journal of the American Chemical Society*, H. E. Howe, editor of *Industrial and Engineering Chemistry*; W. A. Noyes, editor of *Scientific Monographs*, and H. E. Howe, editor of *Technologic Monographs*.

The *ad interim* report of the finance committee was accepted. It showed estimated receipts and expenditures of about $302,000 for the year.

The committee on intersectional meetings reported progress and was continued.

The committee on classified membership reported progress and was continued.

It was voted to establish a local section with headquarters at State College, Pennsylvania, as soon as the requirements have been met by the chemists petitioning.

It was voted that the council encourage the holding of intersectional meetings with Section C of the American Association for the Advancement of Science.

The invitation to hold the Spring Meeting of 1924 in Washington, D. C., was accepted.

The invitation to hold the fall meeting of 1924 in Ithaca, N. Y., was accepted.

A vote of thanks was passed to those in Milwaukee who had made the meeting so successful.

CHARLES L. PARSONS,
Secretary

SCIENCE NEWS

A PERMANENT NEW STAR

Science Service

THE remarkable new star in the constellation of the Serpent, which unexpectedly rose from obscurity fourteen years ago, still maintains its brightness and thereby justifies for it the title of the "only genuine new star," according to stellar photographs recently made at the Harvard College Observatory. The stars ordinarily called "new" by astronomers are really but temporary affairs that fade away rapidly within a few days or weeks after their sudden appearance.

This interesting object, which has been given the name RT Serpentis, was originally discovered by an astronomer at Heidelberg, and later quite independently at the Yerkes Observatory in Wisconsin. It was, however, on record earlier, for a subsequent examination of the store of celestial photographs at Harvard showed the star coming out of darkness nearly a year before its discovery by the German astronomer. For twenty years before that time the Harvard plates give no trace of it.

RT Serpentis was first classed as one of the Novae, or "new" stars, and it also was expected to fade away as all of them have done in the past. But this object proved to be an exceptional phenomenon. It has now maintained its maximum brightness at the tenth magnitude for thirteen years. Measures of the parallax show that its distance is about one thousand light-years.

Scientists have not yet explained satisfactorily the singular behavior of RT Serpentis. Three possible interpretations, however, have been suggested by Dr. Harlow Shapley, director of the observatory.

Could this actually be a new star evolving from a non-luminous and nebulous beginning? A star birth has indeed never been witnessed, and it is not known in what manner stars first become luminous. RT Serpentis already shows signs in its spectrum which indicate that it is well along in its life history; but perhaps for stars of certain size some of the early evolutionary stages are lived through with great rapidity, and this star's birth was actually witnessed in 1909.

The second suggestion is that RT Serpentis is only a variable star of large range in brightness, with a very long interval of time between successive appearances. This explanation would require that sooner or later the star will again decrease in brightness, possibly to return to its present magnitude in some other generation.

The third suggestion proposed, and the one that Dr. Shapley thinks most probable, is that RT Serpentis is an ordinary unvarying star that has recently emerged from behind some obscuring cloud of cosmic dust. Many dark nebulous clouds are known to exist in the Milky Way, some of them at no great angular distance from RT Serpentis. Photographs of the region have been made, and all the stars nearby have been catalogued. If at some future time another star in this region should come or go, the existence of an obscuring cloud may be accepted as very probable.

FLYING AT HIGH ALTITUDES

Science Service

BY using a new device which feeds his engine air at normal sea-level density, Lieutenant John A. Macready, of the U. S. Army Air Service, will attempt within the next few weeks a rise to atmospheric heights rarer than those ever reached by man. The new equipment is now being installed on his plane at McCook Field. Lieutenant Macready was holder of the world's altitude record of 34,509 feet until two weeks ago when Sadi LePointe, a French aviator, was officially recognized as world champion with a record of 35,178 feet.

The "ceiling" for an ordinary airplane is about 21,000 feet, because the air above that is too rare to support combustion in the engine. In establishing his present record, Lieutenant Macready made use of a supercharger which supplied his engine with the necessary oxygen by compressing the rarified upper air through which the plane climbed. The much more efficient device, designed and built by the General Electric Company, which is now being placed on the plane, should feed atmospheric pressure to the engine at 35,000 feet.

This supercharge is mounted just back of the propeller blade of the plane on the front end of the liberty motor. It is operated from the motor's red hot exhaust, which ordinarily goes to waste. Its weight of about 140 pounds will cause a small loss of speed at the low altitudes, but will produce a decided gain in power at 35,000 feet equal to about two horsepower for each additional pound carried.

The pressure of the atmosphere at an altitude of 35,000 feet is about one fourth that at sea level. The temperature is 58 degrees Fahrenheit below zero. To supply the airplane engine its normal air at sea-level pressure, the supercharger is designed to compress about 2,200 cubic feet of atmosphere per minute. The new supercharger has a rated speed of 33,000 revolutions per minute, but in tests at the Lynn Works of the General Electric Company, it was operated up to 41,000 revolutions per minute, or 683 turns of the compressor wheel a second, a speed greater than ever before developed by a commercial machine.

To better visualize what such speed means, Dr. S. A. Moss, engineer, who designed the supercharger, has figured out that if any small object were placed at the outer end of one of the small revolving propeller blades it would travel 1,880 feet per second, or about three fourths the speed of a bullet from an army rifle.

Any object revolving at this terrific speed has an enormous centrifugal pull, and Dr. Moss in tests has determined that if a one pound weight, with its center of gravity located at the center of gravity of the supercharger blades, was revolved at 41,000 revolutions per minute its centrifugal force would be 222,000 pounds, or 111 tons. The blade of the machine, however, weighs but nine thousandths of a pound and the centrifugal

LOST OR STOLEN

About commencement time, June, 1923, a Leitz research petrographic microscope (practically new) disappeared from the petrographic laboratory at the University of Oregon. This microscope carries the following descriptive symbol: "SM" No. 0 No. 209681. Only one eye-piece and one objective were taken with it. All other accessories were lett. Anyone having any information as to an instrument answering this description will please communicate with

WARREN D. SMITH,
Department of Geology, University of Oregon

force per blade in the supercharger is therefore about 2,000 pounds.

DINOSAUR EGGS

Science Service

DISCOVERY of small fossil eggs of the huge dinosaurs which millions of years ago splashed through the tropical swamps where the bleak bad-lands of the Gobi Desert of Mongolia now lie, is hailed by scientists as important but not surprising. While eagerly awaiting more complete details of the find made by the Third Asiatic Expedition of the American Museum of Natural History, they point out that all reptiles are hatched from eggs and that it has always been held that the prehistoric giant reptiles were no exception to this rule.

It is just by the rarest luck that eggs of fossil creatures are ever found, according to Dr. J. W. Gidley, vertebrate paleontologist of the U. S. National Museum, who explained why no such eggs had ever been found among dinosaur remains in this country. Bones may be preserved by merely becoming buried, but the more fragile egg is not so easily fossilized. It should be remembered that eggs are over ninety per cent. water, and water does not petrify.

Fossil bird eggs have been found, however, he said, and in most such cases the egg shells had been cracked, allowing material to sift into the egg or the egg had formed a cast for the accumulating mineral matter. It is possible, but not probable, that embryos of the prehistoric reptiles may be found in fossilized eggs.

Dr. Leonard Stejneger, biologist and reptile specialist, pointed out that all reptiles are hatched from eggs. Whether this hatching takes place outside the body or inside is merely a matter of time. In the case of the rattlesnake, for instance, the young sometimes leave the egg while still within the mother's body, sometimes they are hatched from the eggs outside the body, and in still other cases both these methods of birth occur.

Commenting on the connection shown by the dinosaurs unearthed in Asia with those of America and the indications of a land bridge between the two continents at some remote time, Dr. Stejneger stated that there are little lizards living to-day in the United States which can not be told from species found in China, and that while there are animals here which are not found in Asia and animals in Asia not found in America, there are abundant numbers of other kinds of animals common to both continents and evidently of a common origin.

EXPLOSION AT THE BUREAU OF STANDARDS

Science Service

WORK of the U. S. Bureau of Standards in the investigating of problems connected with the mechanical and economic efficiency of motor fuels will be only briefly interrupted by the explosion of September 20 that killed or mortally wounded several men and wrecked a large part of the building where the work was being carried on. Only one of the three altitude chambers where engines are tested under conditions approximating great heights was wrecked.

The explosion occurred during the testing of a Ford engine under conditions approximating those experienced in winter. Although conducted in the altitude chamber there had been no reduction of the air pressure, which was that of the surrounding atmosphere, but the temperature in the chamber was reduced to about 10 degrees above zero Fahrenheit. The particular test was an acceleration test, using fuels of four different grades. No one was in the chamber, the instruments being read from outside. With the exception of one man who was crushed under the heavy door which was blown from its hinges, all fatal injuries were due to burns.

The general purpose of the investigations, in which the Society of Automotive Engineers is cooperating, is to conserve the supply of gasoline, to make more use of the lower grades by proper carburetor adjustment and to get a greater number of miles to the gallon and for every dollar expended for fuel. Engineers at the bureau state that it has already been shown that the fuel resources of the country may be increased twenty per cent. by the use of lower grades of gasoline formerly wasted, and that a corresponding increase of mileage may be obtained by more efficient carburetor adjustment, but without any material alteration of carburetor design.

The altitude chamber that was wrecked by the explosion was one of three, the first of which was built during the war to test airplane engines and fuels. Pressure may be reduced to the equivalent of an altitude of 30,000 feet and the temperature lowered to conditions which obtain at that altitude.

The first altitude chamber which was the first of its kind in the world when completed in September, 1917, saved tens of millions of dollars to the American petroleum industry and made unnecessary additional restrictions on privately operated motor cars during the war period. With the data thus obtained on many kinds of fuels the American representatives went into the Inter-Allied Petroleum Conference and showed definitely that American aviation gasoline was superior to that demanded by the French. Since the war the tests made in these chambers have been of great value in the direction of fuel economy and in making possible flights at great altitudes.

LACK OF HURRICANES

Science Service

"YES, we have no hurricanes this year" is the verdict of the U. S. Weather Bureau on one of the most remarkable features of a year noted for the freakishness of its weather. Although the month of September is the season when the dreaded West Indian storms are normally most frequent and severe, not a single one has so far occurred either during the month or throughout the entire summer. Such a record is practically unknown in Weather Bureau annals, and entirely so in the experience of Chief Forecaster E. H. Bowie, who for many years has been responsible for the hurricane warnings sent out.

"The reason for this extraordinary record," said

SCIENCE

VOL. LVIII   OCTOBER 12, 1923   No. 1502

CONTENTS

SCIENCE: A Weekly Journal devoted to the Advancement of Science, edited by J. McKeen Cattell and published every Friday by

THE SCIENCE PRESS

Lancaster, Pa.   Garrison, N. Y.
New York City: Grand Central Terminal.

Annual Subscription, $6.00.   Single Copies, 15 Cts.

SCIENCE is the official organ of the American Association for the Advancement of Science. Information regarding membership in the association may be secured from the office of the permanent secretary, in the Smithsonian Institution Building, Washington, D. C.

Entered as second-class matter July 18, 1923, at the Post Office at Lancaster, Pa., under the Act of March 3, 1879.

AGASSIZ AND THE SCHOOL AT PENIKESE[1]

IN establishing the Anderson School of Natural History, Agassiz transferred his methods of instruction from his brick and iron-girded museum in Cambridge to the wooden barn-like structure at Penikese. The work was to be based on observation and experiment. Animals alone were to be studied, and in every instance the animal was to be under the eye of the student; nowhere was a list of books suggested for reference or consultation, and recitations consisted in answering the questions asked by the teacher as to what the student had observed in his studies. As in the Cambridge Museum the student had set before him a long, shallow tin pan, and in it was placed a fish, crab, lobster or some other animal, alive or dead, alcoholic or dry, and he was required to study and dissect it. Scudder, the entomologist, gave an amusing account in *The Atlantic Monthly* of his initial experience as a student of Agassiz in Cambridge. His previous natural history studies had been almost exclusively confined to butterflies and after his experiences with these dry and charming creatures he had placed before him a big fish which he was required to haul out from a jar of alcohol which was charged with the odoriferous juices of many previous specimens. This bad smelling object he had to examine for three days and to tell Agassiz what he had seen. Among other results this method taught students to use their eyes, an art already acquired by Scudder in his previous study of insects.

Agassiz realized in opening this school what temptations would arise in living near the sea side, and in an early circular he suggests the stipulations he required of the students by saying, "I must make hard work a condition of continued connection with the school, and desire to impress it upon the applicants for admission that Penikese Island is not to be regarded as a summer resort and relaxation. I do not propose to give much instruction in matters which may be learned from books, I want, on the contrary, to prepare those who shall attend to *observe for themselves*. I would, therefore, advise all those who wish only to be taught natural history in the way it is generally taught, by recitation, to give up their intention of joining the school." This sound advice was

[1] Address at the celebration of the fiftieth anniversary of the founding of the school at Penikese, Wood's Hole, August 13, 1923.

generally followed, although at the outset three young men ventured to relieve their animal spirits, or to "cut up," under the plea that "boys will be boys," and were promptly requested to leave the island, which they did. Recreation at the proper time was allowed, however, and we all went in bathing or sauntered over the island. I recall very vividly the first Sunday of the term; it was gloomy to the last degree. It reminded one of Taine's definition of London on Sunday, "a huge but well-regulated cemetery." The students kept rigidly to their rooms. On the second Sunday I induced Professor Wilder and other teachers to join me in a game of croquet (tennis was unknown in this country at that time), and this example by the teachers changed the whole complexion of things and the students came out of their rooms and roamed over the island, or collected specimens along the shores. In the evening we all joined with the students in a singing fest out of doors. If I remember rightly, the songs we sung were the good old-fashioned hymn-tunes, and this performance satisfied the more religiously inclined.

Some of the teachers had brought their families with them, and my little boy, four years old, was fond of wandering through the laboratory and curiously examining the contents of the dissecting pans. At one table Miss White, a teacher from New Bedford, was studying the gross anatomy of a cat. The creature was eviscerated, and Miss White was hard at work on the body with her dissecting scissors and needles. The boy came along and looked over the disemboweled creature, and the teacher, expecting some exclamation of disgust, leaned back in her chair curious to know what observation the child would make. Finally after a critical examination of the remains and the dissecting implements, he turned to her and asked, "Miss White, are you trying to mend that kitten?" Certainly a most natural question, as the cat was evidently in need of extensive repairs.

Many of our students became professors of natural history in our colleges and universities. David Starr Jordan became president of the State University of Indiana and, afterwards, of the Leland Stanford, Jr. University of California; Charles O. Whitman became professor at the University of Chicago, and for years was the able director of this laboratory during its greatest period of emergency; William K. Brooks occupied the chair of zoology at Johns Hopkins University and Charles S. Minot became professor of embryology at the Harvard Medical School.

At Penikese, Whitman and I were engaged in the study of the Ascidian Perophora and on comparing our drawings of this animal I found that his drawings were better than mine and, remembering this fact several years after, I appointed him as my successor to the chair of zoology in the Imperial University of Tokyo, where he introduced section cutting, the staining of tissues, etc.; new methods which he had learned at the University of Leipsig under Leuckart.

It is interesting to observe that among a class of zoological students a number seem to absorb intuitively the salient points in every investigation, and others seem totally blind to the significance of what they study. Simple figures even escape their memory. I recall a story told of Professor Cleveland, of Bowdoin. He always showed irritation at the inattention of students, and in one of his lectures on chemistry he interrupted his discourse by peremptorily asking an inattentive boy, "How many elements did I say there were?" Of course the student did not remember a figure that he had probably heard a hundred times and nudged a student next to him who whispered "sixty-two," the number of elements then known. All he caught was "two" and this number he called out promptly and loudly. The professor gave him a contemptuous glance and resumed his lecture. The student realizing that the professor had been greatly annoyed went down to the platform after the lecture and in order to placate him asked him, "How poisonous did you say cyanide of potassium was?" The professor with much emphasis said, "I told you that cyanide of potassium was so poisonous that a drop on your tongue would kill a dog." Certain students attend courses of lectures and are utterly unable to carry away a single fact. Sir Michael Foster told me of an experience he had in a course of lectures before the Royal Institution on human anatomy, illustrated by diagrams and objects. At the end of his course, one of his auditors asked him whether the cerebellum was inside or outside of the skull! and he further added that Huxley had told him of a similar experience. He was also lecturing on human anatomy and at the close of one of his lectures an auditor came to the platform to ask him some question and noticing a human skull lying upside down on the table incidentally remarked, as he poked his finger into the foramen magnum, "Many a good chunk of bread and butter has gone through that hole!"

Naturalists are born, not made. Sir David Gill, the director of the Royal Observatory at the Cape of Good Hope, in a review of a memoir on "Double Star Observations," in speaking of the authors, said, "It is a special faculty, an inborn capacity, a delight in the exercise of exceptional acuteness of eyesight and natural dexterity, coupled with the gift of imagination as to the true meaning of what he observes, that imparts to the observer the requisite enthusiasm for double star observing." These words may truthfully apply to the work of the naturalist.

Agassiz fully imbued with the classification of

Cuvier emphasized the importance of the study of examples illustrating the four types of Cuvier and the students had in turn a radiate, a mollusk, an articulate and a vertebrate to dissect and study. He not only lectured on these subjects but gave to the school a course of brilliant lectures on the glacial theory. At this point I must emphasize the fact that Agassiz was a wonderful teacher. The charm of his manner and his speech, rich as Apollo's lute, as Governor Banks said at the dedication of the museum, with its slight foreign accent, enabled him to talk on radiates, for example, to a lot of hard-headed Massachusetts farmers at the General Court and secure appropriations of thousands of dollars for his museum at Cambridge. He strongly opposed Darwin's views, but few realized the leading cause which probably animated his strenuous opposition. In 1859 Longman published a separate volume of Agassiz entitled "An Essay on Classification," which had formed the introductory chapter to his "Contributions to the Natural History of the United States." In this essay he had insisted that classification was natural, that the various categories of classification—branch, class, order, family, genus and species were as distinctly created as the individual. Simultaneously with the appearance of this valuable essay appeared Darwin's immortal work on the "Origin of Species," in which it was shown that classification was artificial, not natural, that categories of structure were the results of slow and diverging modification—in other words, that natural selection and not special creation was the cause of all this diversity of animal life. De Candolle, the illustrious French botanist, when he became acquainted with Darwin's view remarked "That it was not a theory, nor an hypothesis, but the explanation of a necessary fact, to deny which would be to deny that a round stone would not roll down hill farther and faster than a flat one." However, Agassiz's essay with the unhesitating endorsement of the views of Von Baer unwittingly supplied the strongest material for Darwin's views and led Agassiz's students, one after the other, to embrace them.

Among the various accounts that were published about the Agassiz School at Penikese was one by David Starr Jordan in *The Popular Science Monthly*, 1892, Vol. XL. In this article, Dr. Jordan gives extracts from a journal which he kept when a student at Penikese, wherein he had recorded sentiments and expressions of Agassiz given in his lectures and comments to his class.

The distinguishing feature of the Anderson School of Natural History lies in the fact that it was the first one of its kind organized in the United States and furthermore that this initial experiment was under the direction of the greatest teacher of natural history in the world. Other schools of a similar nature under the auspices of colleges and universities sprang up in various parts of the country. I do not know the chronological sequence of these summer schools of natural history, but, if I mistake not, the Salem Summer School came next, in 1876. Among the teachers of this school were three who had been associated with Agassiz at Penikese—Packard, Putnam and the present writer. Of all the summer schools in the country the Marine Biological Laboratory easily comes first in the number of its instructors, buildings and equipment, and superadded to this foundation its proximity to the United States Fish Commission gives it unparalleled advantages over all other schools of this nature.

Edward S. Morse

PHYSICS AS A CAREER[1]

It is said of the famous Clerk Maxwell that throughout childhood he continually asked the questions, "What's the go of that? What does it do?" Vague answers did not satisfy him but aroused the more distinct demand, "But what's the *particular* go of it?" Maxwell had the opportunity of devoting a life to the answering of this question, many times repeated, and of rendering such service to mankind that he will be forever highly honored among those known for their important contributions to the field of physics. Do the incipient Maxwells of to-day have in America a similar opportunity? They do, but there is danger that this fact is either unknown to them or not known sufficiently early in life.

A boy does not know of a physicist in his community and the stories of achievement in physics which he may read refer to very distant realities. Moreover, so far as he is aware, physics is not a profession. As he surveys his known opportunities for a life-work, engineering may be the only profession that seems to have an interest in the "particular go" of things. The purpose of this article is to present briefly and with directness the opportunities in physics in our country to-day. It is assumed that, given the possibility of earning a livelihood, one will choose the career which most nearly satisfies his intellectual requirements. Since the aptitude for physics is usually distinct, a comparison of the profession of physics with others is thus unnecessary. The follow-

[1] This is one of a series of articles which are being published in Science and in *The Scientific Monthly* describing to young men and women in American colleges and universities who contemplate entering upon a professional scientific career the opportunities in various lines of scientific work. This series has been prepared at the suggestion of the Division of Educational Relations of the National Research Council.

ing statement is intended merely to give one who is already interested an assurance that there is an opportunity for the physicist which is limited only by his ability.

The chief avenues open to physicists are found in education, in industry and in government service. What is the prospect of a permanent demand for physicists in these fields? The number of teachers required for our colleges and universities has grown with the rapidly increasing number of students. From educators we learn that the demand for an increase in educational facilities is not occasioned by a temporary interest, but by a realization of the value of education and by a response accentuated through the adjustment of our educational institutions to the more obvious needs of the people. The growth of our educational institutions is therefore certain to continue to be rapid. The industries, particularly those interested in electricity, have grown with tremendous rapidity and have simultaneously expanded their research and development laboratories. The experience gained has demonstrated the constant necessity of improvement of products, of cheapness and of service. It is therefore reasonable to expect a continual increase in the facilities of these laboratories and in the number of physicists employed. The government laboratories have grown with similar rapidity. Thus, in every line of activity of the physicist there is an indication of a permanent demand. The profession of physics is established. A physicist may be a teacher only, he may combine teaching and research, he may devote himself to investigation, to development or to a combination of the two, or he may become an administrator in industry.

Teaching

Every college student is aware of the compensation in the life of a professor. He is not handsomely rewarded in money, but he lives simply. His family may be deprived of very expensive pleasures, but his children have opportunities for the development of brain and character that can scarcely be measured in terms of money. The real teacher enjoys thoroughly the opportunity of aiding in the development of the young that come into his classroom. He has a vision of helpfulness and of the indefinite extension of his influence through others. It is frequently the teacher in the college, perhaps an investigator in only a small way, who has the best opportunity to assist young men in finding the professions to which they are best adapted. Also, he is responsible in part for the important contributions to physics made by his former students. This is a part of his compensation.

Teaching and Research

In the large educational institutions the teacher is an investigator who may select for study whatever field he chooses. He receives no demands from his superiors for results that are of immediate practical importance. He is free to choose for investigation any problem that catches his interest and fires his imagination. His intellectual opportunities are without limiting boundaries, and his attainments are determined solely by his ability. Yet he has the satisfaction of serving also through his teaching, his contributions and his students who subsequently become productive physicists.

Research, Including Development

Upon industrial as well as purely scientific research depends the future development in the products of industry. So active has been the development of electrical applications that the opportunities for research physicists have increased rapidly. The example set by large industries in the employment of these physicists is being followed by others. In 1921, there were forty or more such laboratories employing physicists. The nature of the need of research may be illustrated by reference to the art of telephony. As perfect as the art is to-day, the increase in the congestion of business in our great centers and the demand for long distance communication, both telephone and telegraph, have necessitated improvements in transmission undreamed of a few decades ago. Yesterday, conversation between New York to San Francisco was a wonderful achievement. To-day it is common-place. The research laboratories have solved the problems in physics involved and the development engineers have adapted the solutions to practical service. But the research laboratories are interested not only in the problems pressing for immediate solution, but they must, so far as possible, foresee the demands of the future. While the research physicist in an industrial laboratory does not enjoy entire freedom in research, yet the desired applicability of his results supplies a challenge to his best powers and his success gives keen satisfaction. One must not gain the idea that the research laboratories are demanding merely experimental physicists. They employ also mathematical physicists who never experiment. In fact, it is appropriate here to say that every physicist must be a theorist. The subject has become so involved that he must usually depend upon mathematical reasoning to determine the plan and method of his experiments.

Government Service

The Bureau of Standards is now the greatest laboratory of standardization and allied research in the world. Its physicists are employed for the most part in testing for the various industries and educational institutions of the country. But, at the same time,

physicists have there been enabled to make some of the most distinguished of the recent contributions of America to physics. Other bureaus, for example, the Weather Bureau, also employ physicists.

Administration in Industry

More and more is recognized the value of a scientific or technical training for men in administrative positions in industry. Some of these are in connection with research only, but others are in the business organization itself.

The Financial Compensation

If this brief article were to discuss the attractiveness of physics as a career, it would present the intellectual appeal as the most and the financial appeal as the least important. But it is assumed that the reader is already more or less aware of the nature of the various compensations enjoyed but needs especially to be informed as to the amount of salary that, at the present time, may be expected by an established physicist. In the colleges of recognized standing, the minimum salary of a professor for the college year of nine months is approximately $2,500. A few receive $2,000 or less; many receive more than $3,000. Of course, the scale of living in the community is as important a consideration as the salary itself; yet it is impracticable to introduce living costs into this presentation. In the large universities of the country, a similar position pays from $4,000 to $6,000, with exceptional higher salaries. In government service the salaries are practically the same as in education. In industry the highly trained physicist, if successful, may anticipate at the end of five or six years a salary of $5,000 or $6,000. There is no upper limit in industry for men either in research or in administration.

Ability

The desirable innate ability of a prospective physicist is not definitely known in detail and its measurement is even less certain. Comments thereon must hence be somewhat general. The special requirements for a successful teacher, a research worker, a development engineer and an executive in industry need not be described, as many of the differences are apparent to the student. But it is well to remark that a career in physics demands not only rigorous thinking but also that type of persistence and patience which is required in any worth-while endeavor. Of course, there is always a chance of an accidental scientific discovery of importance, but it is very much smaller than is commonly believed. It is a matter of interest that no physics research laboratory, industrial, governmental or educational, is organized to encourage especially accidental discoveries. Real contributions may arise through accident, but progress in research is usually by a procedure based upon deductions obtained through analysis. Moreover, the purely experimental physicist is vanishing with the increased complexity of the field, and a student who can not use mathematical methods will find therein an increased difficulty in attaining leadership in investigation in the years ahead. An aptitude for analysis, a noticeable mathematical ability, a deep interest in the "particular go of things" and a courage comparable to that in any profession are essential for the highest success.

Preparation

The preparation required depends upon the nature of the position. There is a demand for those with a college degree as well as for those who have pursued graduate work and have received the M.A., M.S. or the Ph.D. degree. Research and development require clearness of thought, a knowledge of the field and a confidence that comes through experience in intellectual effort. It is obvious that graduate study will develop these qualities and hence will increase the physicist's value. In education, most college and university positions demand the Ph.D. degree, though a number of minor colleges do not insist upon a preparation beyond the Master's degree. In industry the difference in preparation is recognized at the outset by a difference in salary. But it is in the long run that training shows its value. It may be said that the more ambitious a physicist the more concerned he should be to secure the best educational preparation possible. The nature of this preparation may be inferred from an earlier comment. The theories upon which researches are based are usually mathematical and the student who wishes the best chance for advancement in his career must emphasize mathematics as well as physics. If one is especially fond of mathematics he may well aspire to become a mathematical physicist. In such a case the mathematical training possible in the requirements for a Ph.D. in physics is not sufficient. There are a number of adequately equipped graduate departments of physics in this country and young men of ability will find available graduate appointments carrying stipends, but which involve no return in service, and graduate assistantships which give an opportunity for self-support. The former is to be preferred, for the combination of teaching and study found in the latter requires a longer period of preparation. The way to the top is not short and an ambitious young man needs to save all the time possible.

In general it is fair to say that high attainment as a physicist is difficult. It is in this difficulty, however, that the challenge and ultimately the joy in suc-

cess rest. If one goes into business to make money he will seek, if possible, an unlimited opportunity. If one enters upon an intellectual career he desires the opportunity to achieve the highest success of which he is mentally capable. He wishes to be limited by nothing save his own ability and industry. A physicist has just this opportunity. He need not wait for business to grow or clients to appear. He can study and contribute to the most important and fundamental problems in physics of the day. He can, if his researches are published, attain without difficulty nation-wide recognition for what he has accomplished. As a consequence he can not avoid chances of advancement appropriate to his ability. His light is upon a hill and can not be hid.

The purpose of this paper is to present to interested students facts without persuasive enthusiasm, and hence to attract to physics as a career only those whose ability and intellectual ambitions can turn a plain statement of facts into an appeal.

GEORGE WALTER STEWART
UNIVERSITY OF IOWA

A COURSE IN GENERAL SCIENCE

IT may be reasonably conjectured that at every university in the United States the elementary courses in science are overcrowded. Complaints take various forms: Instructors have no time for research; students can not be interested or even taken care of; weak but industrious students fail in large numbers.

Under the circumstances it might well seem that a possible remedy for the situation has been overlooked. Have we not made the teaching of the individual sciences too much of a fetich? Can not something be said for the giving of a course in general science?

Objections in quantity come to mind. But most of them reduce to one of three points. No instructor knows enough to teach a worthwhile course in science in all its major branches. If such a person were found, the chief values of science teaching would be lost in what would necessarily be a lecture course. In any event, one more "snap" would be added to a curriculum which at least theoretically opposes easy courses.

Yet one may doubt whether, if there were a demand for lecturers on general science, supply would not follow. The writer has found a considerable number of students drifting through non-scientific "majors," yet taking for diversion a creditable quantity of differing sciences. Certainly these students could not teach any one science, even in an institution of reputable high school grade. Very often they are only mildly attracted by the experimental side of the sciences. So much may be granted. But, incidentally, they are usually far more interesting talkers and writers than us professed and lettered scientists; they might develop into very effective teachers of general science, if there were any inducement.

Doubtless the first set of such teachers, if not those of a later date, would make gross errors. It is too early to pretend to know what should be included in a course in general science. Possibly it might have running through it the basic idea of explaining evolution in its many forms from the Rutherfordian theory of radioactivity to the development of man from *Pithecanthropus*. But suppose the worst. Suppose a man who taught general science, and who knew nothing to speak of about electrons and explained valence with utter disregard of the newer chemistry; who gave his students in astronomy and geology La Place instead of Moulton and Barrell; who did not know that the thallophytes are a very miscellaneous group of plants, lumped together because none of them are bryophytes, pteridophytes or spermatophytes; who—but finish the heinous list for yourself, if you are a physicist, biologist, etc. Under our present system there seem to be some *Sigma Ksis* who discourse well on benzene rings and think chromosomes are plants; who can bound every ore deposit in America and blithely call whales fishes. Isn't it possible we have out-Huxleyed Huxley in our desire to flee from Greek and Latin? Which is worse: To have, as we do have, groups of young scientists who are really only organic-chemists or statistical geneticists or other ists, or to have scientists with a trifle less of specialties and an ABC knowledge of the fields of their fellows?

Besides, the confessedly inferior knowledge of this hypothetical teacher of general science is meant only for that vast group of students who can be attracted to science as a study of the laws of astronomy, chemistry, physics, but who revolt from the laboratory notebook and the minutiae of topographic maps. One great benefit of the suggested course would be the freeing of the enthusiastic laboratory teacher from the incubus of indifferent students—though there is hope that a stimulating approach to modern "organized knowledge" would lead some of the indifferent to further purposeful experimental work. Just as the true laboratory teacher would be relieved and perhaps even be enabled to do research, so would the student genuinely interested in science from the outset find himself among a small group of congenials who would eschew the general course and elect, these chemistry, those botany, etc. Surely, too, since the present courses in elementary this or that could then move far more rapidly, the chemist could find time for botany, the economic geologist time for biology, the mineralogist time for astronomy.

One may doubt, moreover, whether "the chief values of science" would be any more lost than at present.

One new value would be gained. Were all the freshmen who now dawdle through chemistry, biology or botany to return to their villages with an inspiring idea of evolution, in a short time there would be no such specimens of *Titanotherium modernum* as W. J. Bryan. A number, even of the "flappers," would, I believe, come to see the fascination in learning of hydrogen stars, cathode rays, the great seed-bearing fern-like trees of the Carboniferous, etc. It is not the facts of science unrolled as that marvelous tapestry we call evolution that the freshmen revolt from. They revolt from chemical formulas, from stains, from botanical slides of algae—all meaningless to them. If we can interest them in chemistry only by chemistry spelling-matches, we are worse than the Arnoldites whom Huxley fought so valiantly.

Reduced to the last analysis, our own love for the scientific method[1] is, I think, our feeling that we can win truth only by "exact definition, by the nicest" manipulation of instruments, by, in short, driving from our habits of thinking and doing everything that is vague and slovenly. No one need marvel that we shudder at freshman modes of thought and manipulation. But in our *vast, overcrowded* classes, can we even faintly hope to make over those who are frankly disdainful of periodic tables and the minerals in monzonite porphyry, hope to make them think and act as our ideals urge us to think and act? I know a most conscientious teacher of chemistry whose students at the end of a year blithely lay reagent stoppers on desks anything but clean—if no one is looking. Who trusts fragile apparatus in the hands of the average student? If all the students were failed whose quiz papers are but "memory gems," how many seats would be vacant after the first quarter? Why do we use that empty label called the "condition grade"? In other words, does our great run of students ever come to define science as we define it? And, if we do not teach these students *respect* for the scientific method, why pretend to, when we might, let us hope, lead them to grasp the fundamentals of each of the sciences through a properly managed lecture course.

"A properly managed lecture course." Such a course need not be a "cinch." That is the blunt answer to the third objection. For one thing, the working of purposeful problems and individual visits to a "hall of experiments and specimens" might be required.

Some to whom I have talked would not oppose the idea of a course in general science, were each science given by its own specialist. Logically, such lecturing would imply the use of heads of departments. Of course, not many heads are of the type of the learned geologist who spends the first three weeks in his elementary geology in forcing students to pretend to recognize models of scalenohedrons and their ilk, because the peculiarly poor text-book he uses opens with crystallography; or of the type of the chemist who wished elementary chemistry to be elective and who, since his desire was overruled, revengefully makes the course a thing of terror. Yet it is very true that, save for striking exceptions, heads of departments do not like to be censured (or censored), and that each year they become more and more ill-fitted to reach the freshman mind. The teachers of a course in general science should be the target of much criticism, should be enthusiastic, and should, above all, be subject to removal upon well-grounded complaints from their students.

Perhaps, indeed, all professors should be subject to retention or fall with much more reference to student judgment than at present. Undoubtedly, teachers of general science should.

A. J. TIEJE

LOS ANGELES, CALIFORNIA

[1] One interesting phase of the entire question is raised by such facts as these: In a great trans-Mississippi university, geology is not allowed as a "laboratory science," though the usual laboratory work is an integral feature of the course. A thousand miles west, in another high-grade state university, students are given "science credit" for a year's work divided between physiography, climatology, and the geography of North America. The "laboratory" work, aside from slight field trips, consists of the arithmetical and graphical solution of problems, the looking up of names, etc.

SCIENTIFIC EVENTS

HERMANN M. BIGGS

DR. SIMON FLEXNER, chairman of the New York State Public Health Council, has made public a resolution adopted by the council at a recent meeting in New York in honor of the memory of the late Dr. Hermann M. Biggs, state commissioner of health and chairman of the Public Health Council from the time of its organization in 1914 until his death last June. Besides Dr. Flexner the other members of the council as at present constituted include Dr. Matthias Nicoll, Jr., state commissioner of health; Mr. Homer Folks, secretary of the State Charities Aid Association; Professor H. N. Ogden, of Cornell University; Dr. Jacob Goldberg, of Buffalo; Dr. T. Mitchell Prudden, of New York, and Dr. Stanton P. Hull, of Petersburg. The resolution follows:

The Public Health Council of the State of New York, at its first meeting after the death of its late chairman, Dr. Hermann M. Biggs, desires to spread upon its records the following minute:

The relations between the Public Health Council of the State of New York and Dr. Biggs were somewhat

different from those existing between Dr. Biggs and the many other organizations of which he was a member. It was Dr. Biggs who first suggested the establishment of this council. It was his clear vision of the desirability of separating administrative from legislative duties in the field of health, and of placing the latter in the hands of a group, which led the legislature and executive of this state, in 1913, in the revision of the public health law, to create the Public Health Council, and to endow it with quasi-legislative authority.

Dr. Biggs was chairman of the council from its organization until his death. While his official position and his exceptional experience gave him at all times a very great influence in the council, he always sought the consensus of opinion of the council on all important matters of policy. The development of a sanitary code, dealing with matters which the staff of the department and its local representatives were able to manage administratively, has been the chief duty of the council. Not infrequently, however, at council meetings, all routine matters were brushed aside by the commissioner, in order to bring forward some proposed policy or action on which he desired the advice of the council. It is indicative of Dr. Biggs' wise caution that before action he sought to clarify his own judgment and opinions in the light of group discussion.

To every member of the council it has been one of the most interesting and gratifying experiences of life to observe the consistent and continuous development of the policy and the organization of the State of New York in public health under Dr. Biggs' direction. His plans were always far-sighted and comprehensive, but he was always ready to take, at any time, those steps which might then be practicable. If further advances were blocked in one direction, he sought opportunities of moving forward in other directions. Thus, step by step, we have been privileged to witness the development of one of the most important branches of the state government from relatively small beginnings into one of the most complete and effective of public health organizations. The council feels itself unable to indicate in any adequate way the loss to the people of this state which is involved in the death of Dr. Biggs.

His personal qualities, his patience, his soundness of judgment, his unerring estimate of public opinion, his skill in the selection of assistants, and in securing from them their loyal support and the best work of which they were capable, these, as also his many other exceptional gifts, were universally recognized.

The council deplores the death of Dr. Biggs and inspired by his work pledges itself to renewed devotion to the cause for which he labored so fruitfully.

THE DEANSHIP OF THE COLLEGE OF AGRICULTURE OF THE UNIVERSITY OF ARKANSAS

THE agricultural interests of Arkansas are deeply concerned in the choice of the new dean of the College of Agriculture of the University of Arkansas. The entire faculty of that college has addressed to President J. C. Futrall the following letter on the subject:

In view of the fact that the success of the College of Agriculture in its several branches, namely, teaching, station and extension work, and that the working conditions surrounding the members of the staff are in very great measure dependent upon the actions and policies of the dean and director, we trust that we may, without impropriety, set before you our views concerning the type of man that should be appointed to this position:

As director of the teaching in the college, he should be thoroughly familiar with the modern trend of education in agricultural colleges.

As head of the agricultural extension forces, he should be a man who has a grasp of the problems peculiar to that branch of service.

In our judgment, since the Agricultural Experiment Station is the branch of the work that must continually vitalize and enrich all the others, the dean and director should be a man who, through first-hand experience, understands the methods and purposes of modern agricultural experiment.

It is, therefore, highly desirable that the dean and director should have had recent experience in an agricultural college and experiment station lines of activity that have brought him into intimate contact with the problems of such an institution.

While we believe it is desirable to appoint a dean as soon as may be, yet we feel strongly that wise discretion should not be sacrificed to haste in this important matter.

We respectfully request that these suggestions be seriously considered, and that they be transmitted to the board of trustees of the university.

THE SCIENTIFIC EXHIBITION AT THE BRITISH ASSOCIATION MEETING

THERE is printed in *Nature* an article by Mr. M. A. Giblett on the scientific exhibition at Liverpool in which he says:

The ninety-first annual meeting of the British Association, which has just drawn to a close at Liverpool, was characterized by a new and important departure in the form of an exhibition of scientific apparatus, instruments and diagrams. The exhibition was on the lines of that organized each year in London by the Physical and Optical Societies, which is so effective in bringing together the users and makers of physical apparatus, but its scope was naturally wider, and many branches of pure and applied science were represented.

In opening the exhibition on Monday, September 10, Sir Charles Sherrington commented upon the comprehensive and representative character of the exhibits, remarking that it was very appropriate that such a collection should be brought together, and that this—the first of its kind—constituted a definite

development in the history of the British Association. He further referred to the remarkable advances in the making of scientific instruments during the last three hundred years, to the ever-growing importance of instrumentation, and to the unavoidable complexity of the apparatus needed for some of the simplest and therefore the most fundamental of scientific inquiries.

Admission to the exhibition was not confined to members of the British Association, to whom it was free, but the doors were opened to any member of the public on payment of the moderate sum of one shilling for one day only, while three times that amount guaranteed admission at any time during the fortnight of the exhibition. The results for the first week show that this arrangement was happily inspired, and that the exhibition was as popular with the outside public as with members of the association. The number of daily tickets sold was quite naturally largely in excess of the number of season tickets, but the demand for the latter was quite sufficient to justify their issue.

The exhibition committee was fortunate indeed in having at its disposal the excellent accommodation afforded by the Central Technical Schools, Byrom Street, and the exhibits occupied the rooms on three floors of this magnificent building. The fine lecture hall enabled daily lectures, in some cases illustrated by cinematograph films or experiments, to be given by men of science, a feature which contributed in no small degree to the success of the exhibition. The popularity of these lectures is sufficiently illustrated by the fact that arrangements were made for two at least to be delivered a second time—"The Optophone," by Professor Barr, and "Researches in Special Steels," by Mr. S. A. Main (Research Department of Sir Robert Hadfield's, Ltd.). Other lectures included "Ripples," by Professor L. R. Wilberforce; "Research and Industry," by Sir Frank Heath; "Experiments on Coal Dust Explosions in Mines," by Professor H. B. Dixon; "The Compass in Navigation," by Captain Creagh-Osborne, R.N.; "Flame," by Professor A. Smithells; "Kodachrome Cinematograph," by Dr. Mees (Kodak Co., London); "Developments in Wireless Telegraphy," by Commander Slee (Marconi Co., London).

CANADA'S BUFFALO HERD

So successful have been Canada's efforts to save the buffalo from extinction that it has been found necessary, in order not to overcrowd the ranges in the great park at Wainwright, Alberta, to dispose of about 2,000 animals. Sixteen years ago it was the general opinion of naturalists and others that the buffalo was doomed to follow the passenger pigeon and the great auk into oblivion. However, the Dominion Government, through the Department of the Interior, grasped the opportunity to secure a herd of 716 animals, and had them placed in Buffalo Park at Wainwright. To-day the greatest tribute to the government's foresight is the immense herd of 8,300 animals in the reserve; and the increase of these animals when protected and allowed to roam freely over a part of their old habitat has set at rest the fears as to their possible extinction and indicates a possible line of industrial development.

Notwithstanding the number taken from the herd from year to year to supply specimens to other parks in Canada, the United States, Great Britain and other parts of the Empire, it was found that some other disposition must be made of a large number in order that the park might not become overcrowded. Hence the decision, indicated above, to kill two thousand animals, surplus to the requirements of the herd.

All arrangements have been completed for the killing which will be conducted by experienced men under the supervision of government officials and carried out with expedition and the employment of humane methods which will also insure the best economic results. Experiments have been made in every phase of the work and the plans incorporate the most modern methods in connection therewith.

In Buffalo Park certain ranges are retained as winter quarters, where grazing is not permitted in the summer months, in order that ample forage may be provided for the cold season. When the time comes for the migration to the winter quarters this fall the animals which are to be killed will be kept in the main enclosure and not allowed to enter the reserved areas with the main body of the herd. Riders will herd the selected animals and drive them near the buildings where the dressing is to be done. The buffalo will then be quickly dispatched by expert marksmen using powerful rifles, this being the most humane method of dealing with animals of such size and strength.

The autumn has been selected for the killing since atmospheric conditions at this season are more favorable for the handling and preservation of the meat, and also because at this time the buffalo is in prime condition, that is, in good flesh and with an excellent coat ready to resist the severities of the winter.

The contract for the slaughter calls for the preservation of the hides and heads, which will be prepared for market as they can best be utilized. Robes, garments and novelties can be manufactured from the hides, while the mounted heads provide an ornament much in demand. The sum thus secured will be used to help to meet the cost of maintaining the herd, and it is hoped that it is but the beginning of a revenue of considerable proportions from this source.

THE CRUDE RUBBER SURVEY

THE Crude Rubber Survey authorized by the last Congress and undertaken by the Department of Commerce is now under way in every region where preliminary investigations were originally planned. Announcements have previously been made regarding the departure of individual parties to the British and Dutch possessions in the Middle East, to Brazil, and to other parts of Latin America; and the sailing of the investigating party for the Philippine Islands on September 11, marked the completion of the necessary preliminary work of the investigation.

Dr. H. N. Whitford, of the Yale University School of Forestry, who has had experience in conducting investigations of a similar character in Latin America, the Philippine Islands and the Far East, is chief of the Crude Rubber Section of the Rubber Division, from which the survey is being directed. Dr. Whitford is being assisted in the work by J. J. Blandin, who was for several years and until recently, general manager of the Sumatra Plantations of the Goodyear Tire and Rubber Company.

The field survey is being conducted by four parties of investigators, operating in the four major rubber growing regions; namely, the Amazon region, the Middle East, the Caribbean region, and the Philippine Islands. In all, there are over fifteen political units now being covered by the investigators, all of which territories are known to be potential fields for the cultivation of the *Hevea brasiliensis,* commonly known as the Para rubber tree.

The personnel of the expeditions now investigating rubber conditions in the various regions are as follows:

Dr. William L. Schurz, United States commercial attaché to Brazil, has charge of the Amazon party, assisted by Mr. O. D. Hargis, a rubber plantation expert of considerable experience in the Middle East, until recently manager of the Sumatra Estates of the Continental Rubber Company; Dr. C. F. Marbut, chief of the Division of Soils, Department of Agriculture; A. O. Pierro and E. R. Bjorklund, of the Department of Commerce, as secretarial assistants. Four experts from the Department of Agriculture, headed by Dr. Carl D. LaRue, a botanist experienced with the Hevea rubber and its cultivation in the Middle East, are cooperating with this party. The Brazilian party left Para on August 13, *en route* for Manaos, the Beni and Acre territories and Iquitos, prior to making surveys along the tributaries of the Amazon. The party is receiving the utmost cooperation from the Brazilian Government, which has placed at their disposal a river steamer and extended many other courtesies. The Peruvian, Ecuadorean and Bolivian Governments also offer practical assistance when the party enters their respective countries.

In the Middle East, Mr. David M. Figart, special agent of the Department of Commerce, who is well known in far eastern rubber circles, is making a very extensive survey of the existing plantation areas and costs. He is accompanied by J. W. VanderLaan, of the Department of Commerce, as secretarial assistant. Mr. Figart was for several years with the United States Rubber Company in charge of their Middle East Statistical Department.

The investigation in the Caribbean countries, including Mexico and the northern portions of Venezuela and Colombia, is in the hands of a party headed by Mr. John C. Treadwell, a practical crude rubber expert, and until recently Vice-President of the Continental Rubber Company of New York. He is assisted by H. H. Bennett, soil expert of the Department of Agriculture, and C. R. Hill, of the Department of Commerce, as secretarial assistant. Mr. Carlton Jackson, trade commissioner of the Department of Commerce, is making a supplementary investigation of the Maracaibo region of Venezuela. Mr. Treadwell's party is at present in the Republic of Panama, and will shortly undertake further investigations in the other Central American countries and Colombia up the Atrato River.

The personnel of the field expedition to investigate the rubber possibilities of the Philippines, includes Mr. C. F. Vance, in charge of the party; Mr. Alex H. Muzzall, recently connected with the Goodyear Plantations in Sumatra; Mr. John P. Bushnell, assistant trade commissioner of the Department of Commerce, and Mr. Mark Baldwin, soil expert of the Department of Agriculture. Mr. Vance has had previous experience in the Philippines and is thoroughly conversant with the early plantation development in the islands. The party sailed for Manila on September 11. Mr. W. M. Noble, a crude rubber expert of the Firestone Tire and Rubber Co., who had been expected to assist in the Philippine investigation, was unable to accompany the party, but will later be connected with the work in Washington.

In providing the personnel and in the assembling of data the department is enjoying the full cooperation of every important American rubber firm; those which at present own rubber plantations have even made their private records freely available upon request. The Rubber Association of America, Inc., and the National Automobile Chamber of Commerce have appointed advisory committees to assist whenever possible.

The Department of Commerce has selected men qualified by training and practical experience to understand and give consideration to all the various factors bearing upon the economic production of crude rubber and to push the investigation to a successful conclusion. It is believed that the data and information

gathered will be a definite and valuable contribution to the American rubber industry, and thus indirectly to the millions of Americans who use manufactured rubber products in one form or another.

After the return of the various parties to Washington, their separate findings will be assembled in the form of a complete report, which will be made available to interested firms and individuals at the earliest possible moment.

H. N. WHITFORD

SCIENTIFIC NOTES AND NEWS

IT is proposed that the bicentenary of the death of Newton in 1927 shall be marked by the publication of a new edition of his collected works.

MAJOR HENRY J. NICHOLS, Medical Corps of the Army, has been appointed director of the laboratories of the Army Medical School, Washington, D. C. The new building at the Walter Reed Hospital Reservation will be occupied this autumn.

PROFESSOR W. J. V. OSTERHOUT, of Harvard University, has been elected an honorary fellow of the Botanical Society of Edinburgh.

DR. EDWIN PETERSON, lieutenant in the Medical Corps of the U. S. Navy, has been awarded the Duncan medal of the London (England) School of Tropical Medicine.

SIR ARNOLD THEILER, director of veterinary research, South Africa, and Professor Charles Porcher, of Lyons (France), the British and French delegates to the American Veterinary Medical Association convention, recently held at Montreal, have been made honorary members of the association.

DR. ALBRECHT KOSSEL, physiologist of the University of Heidelberg, celebrated on September 16 his seventieth birthday.

DR. J. ENRIQUE ZANETTI, assistant professor of chemistry at Columbia University, and this year chairman of the division of chemistry and chemical technology of the National Research Council, has been made a member of a committee appointed by the League of Nations to investigate chemical warfare.

A TESTIMONIAL dinner was given to Dr. William A. Pusey, president-elect of the American Medical Association, at the first meeting of the year of the North Side Branch of the Chicago Medical Society on October 3. Dr. Pusey gave an illustrated lecture on "A study of the wilderness road to Kentucky—A doctor's diversion."

AT the seventy-first annual meeting of the American Pharmaceutical Association, Henry V. Arny, Ph.D., New York, was elected president for the ensuing year. The Ebert prize, in memory of the late Albert E. Ebert, of Chicago, was awarded to Paul S. Pittenger, Philadelphia, for his paper on "Biological standards of local anesthetics." The following grants were made from the research fund of the association for the year 1923–24: To E. Kremers and K. H. Rang, of the University of Wisconsin, for work on decolorized tincture of iodine and on such other preparations of the National Formulary as time permits—$250; to W. J. McGill, of the University of Michigan, for work on the electrometric titration of alkaloids—$200. These research grants are made annually from the interest accruing from the A.Ph.A. Research Fund, which represents the profits from the sale of the National Formulary.

ELLIOTT S. ROBINSON has been appointed assistant director of the Division of Biologic Laboratories of the Massachusetts State Department of Public Health.

EARLE G. LINSLEY, professor of astronomy in Mills College, Oakland, has been appointed director of the Chabot Observatory to succeed the late Charles Burckhalter.

DR. HAL DOWNEY, professor of histology, department of animal biology, the University of Minnesota, has been appointed American editor of *Folia Haematologica*, an international journal devoted to clinical and morphological hematology. American investigators in this field are urged to send in reprints of their papers for abstracting and original manuscripts for publication.

HERBERT L. J. HALLER, associate chemist, who has been on the staff of the Bureau of Chemistry since 1919 assigned to the Color Laboratory, has resigned to accept a position with the Rockefeller Institute for Medical Research.

DR. J. B. BROWN, formerly associated with Professor Alfred N. Richards in pharmacological research at the University of Pennsylvania, has joined the research staff of Swift & Co., in Chicago.

S. HENRY AYERS, formerly bacteriologist of the dairy division of the Bureau of Animal Industry, Washington, D. C., has been appointed director of research of the Glass Container Association.

V. H. WALLINGFORD, who recently returned from a year's study and travel as a fellow of the Commission for Relief of the Belgium Educational Foundation, has accepted a position as research chemist with the Mallinckrodt Chemical Works, St. Louis, Mo.

THE tuberculosis research fellowship maintained by the Hennepin County Tuberculosis Association at the Graduate School of Medicine of the University of Minnesota, Minneapolis, has been awarded to Frederick Eberson, Ph.D., formerly research bacteriolo-

gist for the Manchuria Plague Service, China, and associate in the research department of the Mayo Clinic, Rochester.

H. A. Kuhn, who has been chief of the department of toxicology of the Chemical Warfare Service for the past four years, has been detailed to the University of Wisconsin for a year for a special course in toxicology under Professor A. S. Loevenhart.

Professor William J. Hussey, director of the Detroit Observatory, University of Michigan, sailed from New York for South Africa on October 4. Professor Hussey will spend several months studying weather and sky conditions, especially in the Transvaal and Orange Free State, in search of a site for the Lamont 27-inch refractor, which is nearing completion at Ann Arbor. The equipment of the present exploring expedition includes a 12-inch refractor. Professor Ralph H. Curtiss is in charge of the Detroit Observatory, during Professor Hussey's absence.

As a result of the recent elections of the American Society of Mechanical Engineers the following officers have been chosen: *President,* Fred R. Low, New York, N. Y.; *Vice-Presidents,* H. Birchard Taylor, Philadelphia, Pa.; George I. Rockwood, Worcester, Mass.; W. J. Sando, Milwaukee, Wis.; *Managers,* E. O. Eastwood, Seattle, Wash.; E. R. Fish, St. Louis, Mo.; F. A. Scott, Cleveland, Ohio. *Treasurer,* Wm. H. Wiley. *Delegates to American Engineering Council,* F. K. Copeland, Chicago, Ill.; J. T. Faig, Cincinnati, Ohio; R. E. Flanders, Springfield, Vt.; Dexter S. Kimball, Ithaca, N. Y.; W. B. Powell, Buffalo, N. Y.; Wm. Schwanhausser, New York, N. Y.; S. W. Stratton, Cambridge, Mass.; C. C. Thomas, Los Angeles, Calif.; P. F. Walker, Lawrence, Kan.

Dr. Alexander Wetmore, of the Biological Survey, U. S. Department of Agriculture, has returned from Hawaii, where he has had direction of an expedition organized by the Biological Survey and the Bishop Museum of Honolulu, in cooperation with the U. S. Navy, to carry out a general scientific survey of the chain of small islands extending northwestward from Niihau to Midway and Ocean Islands. In addition the party visited Johnston and Wake Islands during July and early August. Reports on the extensive collections made will be published, when completed, in the bulletin series issued by the Bishop Museum.

Professor Archibald Henderson, of the University of North Carolina, has a year's leave of absence on full pay from the Kenan Research Foundation. He sails for England on October 17 and will spend the year in research work on relativity in the Universities of Cambridge, Berlin, Rome and Paris.

P. A. Tetrault, assistant professor of bacteriology at Purdue University, has been granted a year's leave of absence to do research work at the Pasteur Institute.

Dr. Edward W. Washburn, of the National Research Council, has returned from Europe and will resume active charge of the compilation of Tables of Physical Constants.

Dr. Karl Imhoff, in charge of the sanitary district of the Ruhr section of Germany, has been in the United States inspecting sewage disposal plants.

Dr. W. W. Lepeschkin, the Russian plant physiologist, has been invited by the Plant Physiological Section of the Botanical Society of America to give a series of lectures in this country at various universities and at the annual meeting with the American Association for the Advancement of Science at Cincinnati. Dr. Lepeschkin will arrive in New York about October 15.

The Cutter lecture on preventive medicine will be delivered by Sir Arnold Theiler, director of veterinary education and research, Union of South Africa, and professor of animal pathology in the University of South Africa, on October 17 at the Harvard Medical School. The subject will be "Phosphorus Deficiency in Animals: Its Effects and Prevention."

Professor E. V. McCollum, of the Johns Hopkins University, delivered an address on animal nutrition before the Science Club at Kansas State Agricultural College on September 20.

The Rochester and Syracuse Sections of the American Chemical Society held a joint meeting at the New York State Agricultural Experiment Station at Geneva on the afternoon of September 29. The formal session of the meeting was devoted to a paper by Dr. D. D. Van Slyke, of the Rockefeller Institute for Medical Research, on "Factors influencing the distribution of electrolytes and water in blood." Dr. Van Slyke returned recently from China, where he organized the research work in biological chemistry at the Union Medical College at Peking. Dr. Dwight C. Carpenter, of the station staff, was in charge of the program.

Sir Humphry Rolleston, K.C.B., president of the Royal College of Physicians of London, delivered the inaugural address at the opening of the London School of Medicine for Women on October 1. The subject of his address was the problem of success for medical women.

A William Farr lecture, on the measurement of progress in public health, was given by Sir Arthur Newsholme on October 4 at the London School of Economics and Political Science.

Dr. A. Biedl, professor of experimental pathology

at the University of Prague, will deliver the first Harvey Society lecture at the New York Academy of Medicine on Saturday evening, October 13. His subject will be "Organotherapy."

Charles Burckhalter, astronomer and meteorologist, director of the Chabot Observatory, died in Oakland, California, on September 20, after thirty-eight years of service in connection with that institution.

Professor Frederick Putnam Spalding, of the School of Engineering of the University of Missouri, died on September 4, aged sixty-six years.

Dr. Stephan von Apathy, professor of zoology at the University of Kolosvár, who was well known for investigations on neuro-histology, recently died at the age of sixty years.

The International Horticultural Congress opened at Amsterdam on September 18. Papers were read on various subjects, including horticultural and plant diseases and the development of the dahlia.

UNIVERSITY AND EDUCATIONAL NOTES

The new building of the Department of Chemistry of the University of Missouri is nearing completion. This building is the third building on the campus to be devoted entirely to chemistry. There will be an auditorium seating 175 students, and laboratory space for 600 students. There are five small research laboratories for instructors, besides administration offices and storerooms. The attic has been finished off into four rooms and will probably be used as research laboratories for graduate students.

A society of Bologna has founded an endowment representing a stipend of 6,000 francs a year for an Italian student of physics and chemistry who desires to do research work in the Curie Laboratory, Paris. The fellowship is endowed for ten years.

Dr. George W. Martin, of Rutgers College, has accepted an appointment in the University of Iowa, where he will be in charge of the work in mycology.

Oscar E. Harder, Ph.D. (Ill.), who has been in charge of the department of metallography in the School of Mines of the University of Minnesota, since 1919, has been given a full professorship. Mr. L. J. Weber, B.S., Ch.E. (Minn.), has been appointed instructor to take the place of Mr. C. M. Reasoner who resigned to become combustion engineer for the Pillsbury Flour Mills.

Dr. William Lloyd Aycock, Burlington, connected with the research department of the Vermont State Board of Health, has been appointed associate professor of preventive medicine and hygiene in the Harvard Medical School.

DISCUSSION AND CORRESPONDENCE

THE STRUCTURE AND ORIGIN OF COKING COALS

Obviously, the logical method of discovering the structural features of coals which, on heating, become coke, is the investigation of thin sections. The best coking coals are, however, very difficult of manipulation, even by the improved methods devised by the present writer. After repeated efforts, success has been reached in the case of the well-known coking coals of the highest grade from the Pocahontas basin and the Connelsville field. In thin sections of these it is possible to determine the presence of quantities of charred wood and of structureless materials derived beyond any reasonable doubt from wood which has lost its organization in the process of transformation into coal. The spores which are so commonly present in bituminous coals from all parts of the world are conspicuous by their absence in coking coals of high rank. It is accordingly highly probable that coking coals as such are of purely woody origin, since they show no evidence of the presence of spores or any considerable amount of the dark matrix characteristic of cannels and oil shales. The hypothesis of the presence of "gelosic" or "algal" material is thus definitely negatived.

The investigation of more recent coals than those of Connelsville or Pocahontas is of interest in this connection. It has been found in certain instances that pure lignite, that is, coal-like substance which is entirely woody, is capable of giving rise to quite typical coke. This has been observed to be the case with lignites, both from the Mesozoic and Modern periods. Obviously, such lignites, representing as they do the modified wood of single trees, leave no chance for misinterpretation. Obviously, the various hypothetical substances which have been supposed to make coals capable of coking are by the very origin of the material excluded. It is interesting to note that coke, which has so completely replaced charcoal in the technique of modern metallurgy, is like charcoal derived from wood. Not all lignitic woods, however, are capable of being coked, and in fact, quite generally in brown coals, they do not possess that capacity. This condition arises out of the fact that the wood in brown coals has in general not undergone the right degree of chemical modification for the product to be a coking coal.

It is important in this connection to emphasize that cannels and oil shales, as such, are incapable of coking, and this conduct in the oven is explained by the fact that they are characteristically composed of a dark matrix and of spores, with a greater or less, but always proportionately small, amount of wood. Since the view has been put forward in many quarters that oil shales are composed of Algae, their conduct, when

subjected to dry distillation, definitely negatives the hypothesis of the presence of so-called "gelosic" substances in coking coals.

It will be clear to the reader from the statements made above that the best coking coals are purely woody in their origin. Coking coals of less value for metallurgical purposes may contain a greater or less amount of spore material, and their grade depends on the proportion of such material. From the large amount of charred wood scattered throughout the structure of Pocahontas and Connelsville coals, it may be reasonably inferred that they represent transport material laid down in open water, and in this respect are similar to other bituminous coals in their mode of origin.

E. C. JEFFREY

HARVARD UNIVERSITY

SEEDS OR TUBERS OF AQUATIC PLANTS

DR. HUGO GLÜCK, of Heidelberg, Germany, the authority on aquatic plants, appealed to the writer last year for help in securing seeds or tubers of certain native American aquatics in order that he might pursue his studies and complete the monumental work on which he is now engaged.

The writer was able last fall to secure for Dr. Glück only a few seeds and tubers, and hopes through this announcement to reach a wider circle of collectors and others who may have an opportunity to collect seeds and tubers of aquatics, and who may be willing to assist Dr. Glück in this way. The writer will be glad to send to any one interested a copy of the list of species which Dr. Glück desires and to forward any material that may be sent in for him.

A. J. PIETERS

BUREAU OF PLANT INDUSTRY,
UNITED STATES DEPARTMENT OF AGRICULTURE

THE STIMULATION OF GASTRIC SECRETION BY HISTAMINE

IN 1920, Keeton, Koch and Luckhardt[1] demonstrated that gastric secretion of Pavlov pouch animals was stimulated by the subcutaneous injection of from 0.5 to 1.0 mg of histamine. Matheson and Ammon[2] have recently confirmed the above findings for man.

In the course of our studies on the genesis of the chemical secretion of gastric juice, we have made observations on the effect of histamine administered via the gastro-intestinal tract.

Our first observations were made on dogs having a Pavlov pouch and a Thiery fistula of the duodenum and jejunum; so that various substances could be applied to the mucosa of the intestine and their effect on the secretion of gastric juice be ascertained. When 100 cubic centimeters of 1 to 1,000 solution of histamine was applied continuously for 20 or 30 minutes to the mucosa of the Thiery fistula, as much secretion of the Pavlov pouch occurred during the hour following the application as was observed to occur in our animals during the second or third hours after the ingestion of a test meal of meat. We next administered to Pavlov pouch dogs by means of stomach tube doses of histamine varying from 50 to 150 mg dissolved in twenty cubic centimeters of water. We observed that 50 mg was just sufficient to provoke a secretion of gastric juice from the Pavlov pouch, while 150 mg provoked a secretion quantitatively and qualitatively equivalent to that excited by a meal of meat.

Such doses of histamine when administered by the gastro-intestinal tract, although comparatively very large, produce no toxic symptoms, as judged from the behavior of the animal.

When 200 mg of histamine are administered by stomach tube to man (only one man has been experimented on up to date), a definite stimulation of gastric secretion results and no symptoms are experienced.

We believe that these observations very probably have a direct bearing on the problem of the chemical secretion of gastric juice, since Koessler and Hanke[3] have recently reported that histidine is decarboxylated almost consistently in the intestinal tract to histamine, which is normally present in the intestinal tract of man.

A. C. IVY
G. B. MCILVAIN
A. J. JAVOIS

UNIVERSITY OF CHICAGO

MEDICAL LICENSURE OF NON-MEDICAL DOCTORS

To the Editor of SCIENCE:

It is possible that my timely warning to non-medical doctors and other parties at interest (SCIENCE, August 3) may be deprived of some of its force by Dr. Woodward's subsequent objections to it (SCIENCE, September 14), if nothing further is written about the matter. He has made a mistake in calling the warning, "an attack on the medical profession." He would not have asserted, as he has, that certain papers appearing July 7 and July 14 were available to me, had he known that my manuscript was in your hands April 22. His fear that your readers were misled by my signature is not well founded; your readers know

[1] Keeton, Koch and Luckhardt: *Am. Journ. Physiol.*, 1920, li, 454.

[2] Matheson and Ammon: *Lancet*, 1923, i (cciv), 482.

[3] Koessler and Hanke: *Journ. A. M. A.*, 1923, lxxx, 1728.

that national societies address their own members through their own journals.

In so far as my note on medical licensure of non-medical doctors offends the medical profession, it does so because the facts therein set forth are *per se* offensive. That is incidental. It was an important object I had in mind. That object was to warn the non-medical doctors and other parties at interest in all of the States to watch their legislatures. This warning will bear repetition.

No one can deny the existence of House Bill No. 348, upon which my warning rests. No one who is informed can deny that this bill was backed by certain groups of physicians. No one can deny what the wording of the bill meant. Some of us discussed this with lawyers and also entered into conference with physicians here in Philadelphia. In these conferences it was found impossible to get the physicians to agree to a re-wording that would be mutually satisfactory. When the physicians who were conferring upon the bill here in Philadelphia finally (at a conference I attended) passed a motion to drop the bill, it appears that the physicians in Pittsburgh who were similarly interested in the bill refused to drop the bill. The bill had to be "killed in Committee" (in the House of Representatives). Possibly no one who read my paper knew that the effective quotations were from the pen of the physician who acted as chairman at the conferences I know about in Philadelphia and who spent time upon the re-wording of the bill itself. Had Dr. Woodward known this he would not have asserted that these quotations represented *merely* the views of individuals.

Who called into being this committee of physicians in Philadelphia, and who advised them? Who wrote the bill? It was legally unnecessary. It was needlessly offensive. It was thoroughly un-American. The men who did these things should ponder Dr. Woodward's well chosen words: "It would be unfortunate, indeed, if indiscreet utterances on the part of any one should hinder the movement. . . ." But if Dr. Woodward meant me, I do not think his remark fits. My warning has probably hastened the advance of the movement by bringing the matter well out into the open and by purging it (let us hope) of certain intolerable features.

Legislatures have to be watched. Witness the passage of a law in one of the States forbidding the teaching of evolution. If this be taken as an example of a response to a misguided majority, then my warning gains force. For we found that the number of physicans in Pennsylvania alone is about the same as the total number of chemists who are members of the largest association of chemists in the United States. Those of us who are not physicians must have ready other arguments than that of the wish of the majority when this matter comes into the several Legislatures. My warning note in your columns is certainly timely; it contains facts that will bear the closest scrutiny; and it is not intentionally offensive.

David Wilbur Horn
Chairman, Committee on Legislation, Philadelphia Section of the American Chemical Society

QUOTATIONS

SCIENCE IN THE MAKING

At Liverpool yesterday there came to an end a meeting of the British Association that will long be remembered as a definite stage in the making of knowledge. This annual congress of science has two chief functions—propaganda to the public and the advancement of knowledge. The face turned to the public was respectable enough. As usual, some of the more distinguished lights, and perhaps the greater part of the minor speakers, showed little talent for public speaking. They entangled themselves in the threads of their own arguments, like dancers in the colored ribbons of a carnival, turned their illustrations into obscurities, or took so long in saying that their time was too short that it left them time for little else. It is not ungracious to insist on a defect that could be remedied by taking pains; oratory is not required, but only a careful and orderly presentment of the subject such as most of the foreign guests, even those who had to grapple with an alien tongue, contrived to exhibit, in marked contrast with the body of our native speakers. There were, moreover, a few contributions that did not add to the dignity or to the effectiveness of the meeting. It may be difficult for a polite chairman to suppress speakers who are plainly in quest of self-advertisement, but there are committees with the function of accepting or rejecting proffered formal communications, and the council would do well to remind some of these of their duties. But in the proceedings generally there was more than sufficient to persuade laymen that science had a living spirit and was a high stimulus to the mind as well as a rich provider of material advantages. From these points of view the less formal addresses to members of the association and others in Liverpool and to citizens in adjacent towns deserved unusual commendation.

The internal work of the sections, the actual congress of those engaged in research, can not be judged by the public attention it received, perhaps, indeed, might be estimated more correctly in inverse proportion to the possibility of reporting it in a form of interest to the general reader. Even such sections as geography, anthropology, economic science, psychology, education and agriculture, apt to attract communications which sit uneasily in the category of science, also accomplished some useful work and gave real students the opportunity of distinguishing between opinion and knowledge. The geologists, ably led by their president, whose address was a model of

hard technical argument, discussed some of the difficult problems in stratigraphy and metamorphosis presented by local formations. The zoologists, amongst whom the presence of students and the younger generation of workers was notable, were also occupied chiefly with strictly technical matters, in which the conjunction of laboratory workers, museum systematists, and those who deal with living animals at sea or on land was very advantageous. In engineering also there was a useful collaboration of the "practical" and the theoretical sides, of the laboratory and the workshop. The physiologists made several concessions to publicity well justified by the contemporary importance of such subjects as diabetes and cancer, but they also had a valuable discussion with the chemists and physicists on the extremely important recent advances in knowledge of the physics of living membranes described by the chemical president in his address. By general agreement the proceedings in the section of botany were of unusual scientific value, although they were of a kind for the most part difficult for laymen.

But the meeting of 1923 owes its success above all to its achievements in physical science. On the borderland of chemistry and physics theories are pressing on each other concerning the material stuff of the universe. A single instance may serve to explain the general trend of the new knowledge. Although for long it has been suspected that the elements were built up of common units differing in number and arrangement, the fractional quantities assigned to them by the most careful observation seemed to forbid the existence of any simple relationship. Professor Soddy and his fellow-workers have now shown that the atomic weights are a mere statistical average, representing the proportions in which substances not hitherto suspected to have separate existences are found mingled in nature. The elements themselves are simple multiples of a common unit. And so in various ways older complexities are being resolved in what are at once higher and simpler unities. Chemical, physical, electrical and magnetic properties are all being reconciled as expressions or presentations of more fundamental properties of more elementary constituents of matter. Nature is turning out to be articulated, built of unit pieces, and these in their mass, size and movements are comparable with the phenomena of light, at present the ultimate and most nearly absolute standard of the universe. The vital interest of the proceedings at the Liverpool meeting of the British Association lay less in the announcement of completed results to the public than in the actual shaping of knowledge in an assemblage of leading physicists and chemists from almost every country in the world under the honored presidency of Sir Ernest Rutherford.—*The London Times.*

SCIENTIFIC BOOKS

Mathematics. By DAVID EUGENE SMITH. Marshall Jones Company, Boston, 1923, pp. x + 175.

THIS interesting little volume belongs to a series bearing the general title, "Our debt to Greece and Rome," edited by George Depue Hadzsits, University of Pennsylvania, and David Moore Robinson, Johns Hopkins University. An announcement appearing at the end of the volume gives 50 titles of the series together with the names of the authors in most cases. The present volume contains a brief introduction by T. L. Heath, who is well known on account of his extensive contributions to the history of Greek mathematics. Its four main divisions bear the following headings: Preliminary survey, the contributions in details, influence of the contributions, and conclusion.

The volume gives a very appreciative popular account of the mathematical contributions by the Greeks and the Romans, and brings out a number of historical facts which are not usually found in a history of mathematics. Hence, it will doubtless be read with profit by many mathematicians as well as by others to whom its popular style and very meager use of technical mathematics should appeal strongly. Mathematics has been called a Greek science, not only by those who find it difficult but also by those who are in position to understand its nature and who are familiar with the fundamental contributions of the Greeks along this line. It should, however, not be assumed that the Greeks developed the greater part of the mathematics of our times. They merely made a good start along certain important lines.

The reader who is mainly interested in actual facts relating to the contributions by the Greeks and Romans might sometimes wish that our author had not made such free use of the hyperbole. For instance, on page 90 we read: "In the first place we owe to the ancients our technical vocabulary, not merely that of mathematics in general and of notation in particular, but that of all the sciences"; while on page 160 we find the following sentence, "It is quite possible that our indebtedness in matters of notation and symbols is not great, and this should be frankly admitted." On page 114 we are told that Fermat was "the greatest genius of modern times in the theory of numbers," and on page 120 it is stated that "with respect to our indebtedness to Euclid, our modern text-books in mathematics are modeled primarily upon his works." This statement may profitably be compared with those relating to the modern tendency towards arithmetizing mathematics.

A question of a more serious nature may be raised as regards the mathematical contributions of the Romans. Our author emphasizes the fact that the Romans contributed practically nothing towards the

advancement of pure mathematics, but he seems to give them too much credit as regards applied mathematics when he speaks on page 12 and elsewhere of the Romans and the Greeks as complements of each other. In particular, the works of Archimedes and of Heron stand out more prominently in applied mathematics than those of any Roman authors, and the Greek work along the line of mathematical astronomy seems to be more important than that of the Romans along the line of land surveying. Our author makes it clear, however, that the Romans were not gifted as mathematicians and this is the main point in question in this connection.

In view of the fact that the author of the present volume is so widely and favorably known it is likely that many readers thereof will be inclined to place unusual confidence in the accuracy of the statements made therein. It seems, therefore, desirable to note here a few modifications and corrections which might otherwise appear uncalled for in such a brief review. Beginning with one of the most important cases we note that on page 137 there appears the following sentence: "It was Eratosthenes the mathematician who found the circumference of the earth to a degree of approximation not equaled by Ptolemy the astronomer, and, indeed, not equaled until modern times." On page 131 it is stated that this result was approximately 25,000 miles. By consulting volume 6 of the well-known *Encyklopädie der Mathematischen Wissenschaften* one finds on page 223 thereof that Posidonius, who was born 141 years later than Eratosthenes, had already obtained a somewhat more nearly accurate value for the circumference of the earth than the one due to Eratosthenes, and that the Arabians who made measurements by order of the caliph Almamun obtained in 827 a still closer approximation. Moreover, according to this authority, none of these results is very close to the truth, since even the best of them misses the actual value by more than 10 per cent.

On page 42 it is stated that Euclid used the term "even-times even numbers" for numbers of the form 2^n. The inaccuracy of this assertion can easily be established by consulting the well-known work entitled "The Thirteen Books of Euclid," by T. L. Heath. On page 282 of volume 2 thereof appears a discussion of Euclid's use of this particular term, and on page 419 of the same volume we find Euclid's proof of a theorem relating to numbers which are both even-times even and even-times odd. This proves definitely that Euclid used the term in question for a much larger class of numbers than those which are of the form 2^n.

On page 66 our author refers to the three different types of algebra noted by Nesselmann in 1842 and frequently quoted in the histories of mathematics; *viz.*, the rhetorical, the syncopated and the symbolic. He adds that "the first is, generally speaking, pre-Grecian, but extends through the classical period as well; the second is late Greek and medieval; the third is modern." On page 4 of volume 2 of Tropfke's *Geschichte der Elementar-Mathematik*, 1921, it is stated that the first of these three types of algebras is found among the Greeks up to the first century after Christ. This is in substantial agreement with the statement noted above, but Tropfke adds that the East Arabs, the Persians, the West Arabs up to the thirteenth century, the medieval mathematicians, such as Leonardo of Pisa, Jordanus Nemorarius and their pupils up to Regiomontanus (1436–1476) also employed this type of algebra. The Arabs avoided symbols to such an extent that they even used words in place of number symbols.

One of the striking features of the volume under review is the fact that the Greek contributions to algebra are given such a prominent position in comparison with those of the Arabs and the Hindus. In fact, on page 129 it is stated that the Arabs "added not a single proposition of importance, nor did they make any progress towards the solution of the cubic or biquadratic equation or towards the approximation of the roots of numerical equations of higher degree. They were translators, popularizers, and text-book writers, but they were not creative algebraists. As to the Hindus, they added nothing worthy of note to the stock of algebraic knowledge except in the way of a symbolism which no later writers adopted, and in the way of numerous interesting problems." These views are especially interesting, since the Hindus and the Arabs have frequently been incorrectly credited with the founding of algebra. The reviewer is, however, inclined to believe that the above quotation does not give enough credit to the Hindus and the Arabs as regards contributions towards the development of algebra.

On page 61 it is stated that the first text-book on conics is due to Apollonius of Perga. This is surprising in view of the fact that it is very well known that Euclid wrote four books on conics, which have been lost, and that Aristaeus wrote five books on the same subject, probably at a somewhat earlier date. It is also surprising to note that on page 37 our author speaks of the choice of the base of the sexagesimal system of numerical notation and of the division of the circle into 360 degrees as if we knew definitely the motives leading to these choices. Most mathematical historians seem to regard these as very difficult unsettled historical questions and various theories have been advanced from time to time to account for these particular choices. In view of the fact that the ancient Egyptians and Babylonians extracted the square root it is difficult to see why our

author says on page 101 "The operation of finding the square root of a number is distinctly Greek."

In closing, the reviewer desires to record one more surprise to himself when he read on page 77 that Diophantus "was searching in general for classes of numbers instead of particular numbers, and it is the class, as such, that is primarily sought in an indeterminate equation." It is well known that Diophantus usually gave only one solution even when the equation under consideration admitted an infinite number of solutions. Mathematical historians usually direct special attention to the fact that the Greeks were satisfied with one solution even in their geometric constructions. The reviewer never saw any evidence in support of the statement that Diophantus searched in general for classes of numbers in the solution of indeterminate equations.

G. A. Miller

University of Illinois

SPECIAL ARTICLES

POSITIVE ION CURRENTS FROM THE POSITIVE COLUMN OF MERCURY ARCS

A negatively charged auxiliary electrode in the path of a mercury arc (as in a mercury rectifier) takes a current which is practically *independent of the impressed voltage* even if several hundred volts be employed. This current, which is usually a few milliamperes per cm²., might conceivably be due either to emission of electrons from the electrode (as for example by photo-electric effect) or to positive ions taken up by the negative electrode. By placing in the ionized gas a negatively charged grid completely enclosing a positively charged electrode, it is found that the current to the positive electrode may remain nearly zero although the positive current of many milliamperes flows to the grid. This proves that the currents are due almost wholly to positive ions taken up by the negative electrode, since electrons from the grid would pass to the positive electrode.

Why are these positive ion currents so nearly independent of the voltage? The explanation seems comparatively simple and is in excellent accord with experiment.

Electrons are repelled from the negative electrode while positive ions are drawn towards it. Around each negative electrode there is thus a *sheath* of definite thickness containing only positive ions and neutral atoms. The thickness of this sheath can be calculated from the space charge equations used for pure electron discharges. Since mercury ions are 200×1848 times heavier than electrons, the currents carried with equal voltage will be $\sqrt{200 \times 1848}$ or 608 times smaller.

Thus X the thickness (in cm.) of the sheath in the case of a plane electrode receiving positive mercury ions with a current density i/A, (amperes per cm²) can be calculated from the equation[1]

$$\frac{i}{A} = \frac{2.33 \times 10^{-6}}{608} \frac{V^{3/2}}{X^2}$$

where V is the potential of the electrode with respect to the surrounding gas. With a current density of ten milliamperes per cm² the thickness of the sheath is thus only 0.02 cm with 100 volts on the electrode; and 0.0035 cm with 10 volts.

Electrons are reflected from the outside surface of the sheath while all *positive* ions which reach the sheath are attracted to the electrode. A change in the negative voltage of the electrode from 10 to 100 volts thus only changes the sheath thickness from 0.0035 up to 0.02 cm and since this displacement of the edge of the sheath is small compared to the free path of the electrons or ions, and the dimensions of the tube, it follows directly that no change occurs in the positive ion current reaching the electrode. The electrode is in fact perfectly screened from the discharge by the positive ion sheath, and its potential can not influence the phenomena occurring in the arc, nor the current flowing to the electrode.

With cylindrical electrodes of diameters comparable with the thickness of the sheath, the variation of the sheath diameter with the voltage causes the effective collecting area for the ions to change so that the currents are not strictly independent of the voltage. This conclusion affords a crucial test of the correctness of the theory, especially since electron emission would follow entirely different laws. The positive ion current flowing to the electrode should be proportional to the area of the outside of the sheath, or in other words to its diameter. This can be calculated by means of the space charge equation for concentric cylinders. For positive mercury ions this becomes

$$\frac{i}{L} = \frac{14.69 \times 10^{-6}}{608} \frac{V^{3/2}}{r\beta^2}$$

where L is the length and r is the radius of the cylindrical electrode and β is a function of a/r where a is the radius of the outside of the sheath. The method of calculating this function has been given[2] and a table of its value as a function of a/r will appear in a forthcoming number of the *Physical Review.*

The experimental data have confirmed the theory by showing that a small diameter of the collecting electrodes and low intensities of ionization cause an increased variation of current with voltage, both of these factors tending to make the sheath diameter large compared to the electrode diameter.

The following typical experimental data were ob-

[1] Langmuir, *Phys. Rev.*, 2, 450 (1913).

[2] Langmuir, *l.c.*

tained with a glow discharge in mercury vapor using a hot tungsten cathode emitting 30 milliamperes. The conditions were such as to give a rather weak ionization, but the results are quite comparable with those observed in the portions of a mercury arc tube where similar ionization occurs.

ELECTRODE RADIUS 0.0635 CM. LENGTH 6.2 CM.

Volts	I obs. m.a.	β	$\frac{a}{r}$	I cal. m.a.
40	0.31	1.40	2.58	0.308
60	0.36	1.77	3.06	0.366
80	0.40	2.05	3.43	0.410
100	0.46	2.26	3.72	0.443
140	0.52	2.74	4.39	0.524

The last column gives currents calculated on the assumption that they are proportional to the values of a/r in the 4th column as they should be by the theory. It is seen that the agreement with the currents in the 2nd column is within the probable experimental error.

The positive ion currents flowing into the sheath in this case correspond to a current density of 49 microamperes per cm². With the more intense ionization in a five-ampere mercury arc rectifier, positive ion current densities of about 30–60 milliamperes per cm² are obtained and these currents, because of the small thickness of the sheath, are much more nearly independent of the voltage even if the electrodes are of small diameter.

This theory, for reasons which can not well be stated in a brief note, leads to the following conception of the positive column of the mercury arc (and of glow discharges in general).

The glass walls of the discharge tube become negatively charged and repel (or reflect) all but a very minute fraction of the electrons that move towards the walls. Since electrons in general make elastic collisions with mercury atoms, the motion of the electrons is in random directions, almost as many electrons moving against the potential gradient in the arc, as with it. Thus an apparent current density of one ampere per cm² in an arc is to be regarded as consisting of an electron current of perhaps 20 amperes per cm² in one direction and a similar current of 19 amperes per cm² in the opposite direction. The positive ion currents, because of the large mass of the ions, are many hundreds of times smaller (10 to 60 milliamperes per cm²). The positive ions, in general, lose a great part of their energy in each collision with the atoms, and thus behave as though all collisions were inelastic.

Few, if any, of the ions move against the potential gradient, but by collisions with atoms they are thrown against the glass walls before having travelled more than one or two free paths, these paths usually being comparable with the diameter of the discharge tube. Enough electrons pass to the walls to neutralize the charges of the positive ions and in doing so liberate in the form of heat, an energy corresponding to the ionizing potential 10.4 volts. Thus a positive ion current density of 10 milliamperes per cm² generates a heat of over 0.1 watt per cm². This accounts for the influences of the size of the tube on the voltage drop in the arc.

A more complete discussion of these conclusions will be published in the November number of the G. E. Review.

IRVING LANGMUIR
RESEARCH LABORATORY, GENERAL
ELECTRIC COMPANY, SCHENECTADY, N. Y.

LATE FERTILIZATION AND SEX-RATIO IN TROUT

THE experiments of R. Hertwig[1] and his pupils have shown conclusively that delayed fertilization in frogs will produce a preponderance of males, in some cultures 99–100 per cent. males being produced. It occurred to me that the trout would afford favorable material for seeing whether this phenomenon could be reproduced in other species. Accordingly, in 1921 and 1922, by the courtesy of the Midlands Fisheries Ltd., and in especial of their manager at Nailsworth, Glos., Mr. Stevens, I carried out some experiments on the matter.

I since discovered that Dr. Mrsic, in Professor Hertwig's laboratory at Munich, had also been working at the subject and had obtained more definite results than I. He had kindly sent me the proofs of his article due to appear shortly in the *Arch. Ent. Mech.*,[2] and allowed me to mention his results.

My own results were as follows:

	Total	Per cent. ♂♂	P.E.
Control '21	119	47.90	± 3.09
Control '22	274	48.17	± 2.04
Late-fertilized '21 (some 4, some 7 days late)	332	54.52	± 1.83
Early-fertilized '22 (7 days early)	319	50.78	± 1.89

Dr. Mrsic's were as under (I have calculated the probable errors for his figures, as these do not appear in his paper):

Control (I)	90	47.8	± 3.55
4 days—7 days late (II–III)	199	39.7	± 2.34
13 days late (IV)	77	50.6	± 3.84
21 days late (V)	57	66.7	± 4.21

[1] Hertwig, R., '05–'07, Verh. Dtsch. Zool. Ges.: '12, Biol. Zentr. 32; '21, Sitzb. Bayr. Ak. Wiss. 1921; Kuschakewitsch, '10, Festschr. f. R. Hertwig, 1910.

[2] Since published while the above was passing through the press.

It will be noticed that all the controls give approximately the same figure. It is probably legitimate to add them together, when we get: Total, 483: per cent. ♂♂, 48.0 ± 1.55.

The differences between Dr. Mrsic's control and (a) II–III and (b) V are: (a) — ♂, 6.31 per cent. ± 4.26. (b) + ♂, 18.9 per cent. ± 5.20. Between (c) his II–III and his V, + ♂, 27.0 ± 4.52. The differences (b) and (c) are significant, (a) is not; however, if the normal sex-ratio be taken as 48:52, to which it clearly approximates, the difference becomes 8.3 per cent. ± 2.34, which, being over 3.5 times the P.E., is significant.

Of my results, the difference caused by the early fertilization is obviously not significant. That caused by late fertilization is not significant, unless the normal sex-ratio be taken as 48:52 ± 0, when the difference is 6.52 per cent., which is over 3.5 times its P.E. of ± 1.83.

Thus, what Dr. Mrsic's figures indicate is that a moderate degree of delay in fertilization causes a preponderance of females, while a considerable degree causes a preponderance of males. He has definitely clinched this by careful histological examination. He finds that sex is undifferentiated to about 120–130 days. Then all individuals show some ova in their gonads; later some gonads continue this female development, but in others the germ-cells divide rapidly, the ova disappear, and the male histological arrangement results. For one short period the gonads appear undetermined and usually mixed ♂ and ♀; but differentiation soon sets in, and is much clearer than in the frog.

Development is similar in all the cultures up to and beyond this point. But in the "21 days late" culture, at about 250 days (when in all controls the gonads are large, sex is obvious even to the naked eye, and the histology of the gonads is normal) many gonads are extremely small and show various stages in the degeneration of ova and a caudo-cranial redifferentiation in a male sense. The samples which he took at intervals from this culture before this point gave an approximate equality of males and females, whereas those which he took after it showed an excess of males as did the final count at 337 days. From this and other reasons, he judges, I think rightly, that he has excluded the idea of differential mortality. He appears to have shown definitely that some gonads which were female-differentiated could no longer continue their development in this phase, but changed over to maleness.

As it appears that all 250-day fish with mixed gonads are in process of sex-transformation to males, I have included seven such as ♂♂ in the figures of Dr. Mrsic's culture No. V (above). If my figures have any significance, they imply that 4–7 days' delay causes a slight excess of males, whereas a similar amount of delay in his experiments led to an increase of females. If this is a real discrepancy, it may be accounted for by the fact that whereas he worked with rainbow trout, I used brown trout. Since he found no histological abnormalities in these "excess female" cultures, one presumes that simply more fish than usual enter upon the female path of development at the time of sex-differentiation, and that there is in this case no true reversal of sex later.

Other extremely interesting points which he establishes are that late fertilization leads to a progressive (a) increase in mortality, especially in early stages, (b) decrease of growth-rate, (c) increase in monstrosities and especially slight shortening of the gill-cover, (d) affecting of the males in these respects more than the females. The retention of the eggs within the body for long periods leads to their partial resorption in many cases, and he believes this interference with their cytoplasm acts unfavorably on general metabolism later.

It is interesting to note that R. Hertwig has recently found by histological examination that the excess of males in late-fertilized frogs is also due to a transformation operating during development, not to an interference with chromosome number as he at first surmised.

It seems, therefore, to be established: (1) that changes in sex-ratio, on the whole similar to those obtained by similar means in frogs, can be produced by delayed fertilization in trout; (2) that the alteration of sex-ratio is never nearly so profound as in frogs (21 days' delay is the utmost so far obtainable, and this is very bad for the female parents); (3) that in both cases there is a transformation of sex during development; (4) that the trout, in which normal sex-differentiation is less variable and uncertain than in frogs, affords excellent material for histological studies on the subject; (5) that many problems of developmental physiology could be advantageously approached in conjunction with this problem in trout.

If laboratory facilities were available at a commercial hatchery, a great deal of very important work could be readily undertaken.

Those who are interested should consult the very full paper of Dr. Mrsic. I hope myself to report shortly on the effects of delayed fertilization on eggs kept outside the body of the fish, instead of, as in these experiments, in the coelom. The expenses of my work were borne out of a grant from the Royal Society.

Julian S. Huxley

New College, Oxford

Cornell University Medical College

First Avenue and Twenty-eighth St.

NEW YORK CITY

The first year of the course is also offered at Ithaca, N. Y., subsequent years at New York City only.

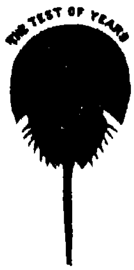
For information address

THE SECRETARY

Marine Biological Laboratory

Woods Hole, Mass.

Biological Material



1. ZOOLOGY. Preserved material of all types of animals for class work and for the museum.
2. EMBRYOLOGY. Stages of some invertebrates, fishes (including Acanthias, Amia and Lepidosteus), Amphibia, and some mammals.
3. BOTANY. Preserved material of Algae, Fungi, Liverworts, Mosses, Ferns and Seed Plants.
4. MICROSCOPE SLIDES in Bacteriology, Botany and Zoology.
5. LIFE HISTORIES, Germination Studies, and Natural History Groups.

Catalogues furnished on application to

GEORGE M. GRAY, Curator

WOODS HOLE MASSACHUSETTS

THE MICROSCOPE

By SIMON H. GAGE of Cornell University

13th Edition, Published December, 1920

In this edition, special emphasis is put upon the Dark-Field Microscope.

POSTPAID $3.00.

Comstock Publishing Co., Ithaca, N.Y.

Turtox Products for BIOLOGY

Jewell Models require little introduction to the progressive American teacher. These preparations now play an important part in the routine teaching of nearly every University and College in the United States.

High School Teachers in ever increasing numbers are adding them to their teaching equipment.

You should have a complete set of Jewell Models. You cannot afford to omit a single one.

The Models now ready for distribution include the following: **Grantia, Earthworm, Fresh water mussel, Crayfish, Grasshopper, Amphioxus adult, Amphioxus development** (20 pieces), **Frog adult, Frog development** (16 pieces), **Chick embryology,** including 24 hr., 33 hr., 48 hr. and 72 hr. stages. **Ten-millimeter pig,** Set showing the stages of **Mitosis** (10 pieces).

New models are being produced at the rate of about one every two months.

These models are strictly American made, and we, the sole producers, guarantee that they will please you.

Send for the Jewell Model catalog today.

General Biological Supply House

1177 EAST 55TH STREET, CHICAGO, ILL.

SCIENCE NEWS

HAWAIIAN EXPLORATIONS

Science Service

THE first scientific expedition ever to attempt a complete survey of the life on Uncle Sam's small isolated and uninhabited oceanic islands which extend west from Hawaii for 2,000 miles, has returned here with large collections of biological specimens, including numerous new species of birds, fish and plants. Dr. Alexander Wetmore, of the Biological Survey of the U. S. Department of Agriculture, who had charge of the explorations, stated to-day that this material may throw much new light upon the distribution of life in the Pacific.

The expedition was undertaken by the Biological Survey in cooperation with the Bishop Museum of Honolulu and the United States Navy. The exploring party was transported to and from the islands by the "U. S. S. Tanager," a one thousand ton ship of the mine-sweeper class, and was out for four and a half months, visiting all the islands and stopping at each long enough to make collections, maps and corrections to existing charts.

From Honolulu to Ocean Island, the westernmost of the group, these islands are either of volcanic origin and rocky and frequently dangerous to approach, or low atolls surrounded by coral reefs.

The mysterious Necker Island, about one mile long, uninhabited and barren, was visited. Here the party saw strange stone platforms, thought to have been built in prehistoric times by Polynesian peoples and used as a religious shrine to which pilgrimages were made from distant islands. The explorers found peculiar idols and implements used by the ancient people on such occasions. Evidently Necker Island was never permanently inhabited, but Nihoa, the nearest island from which the worshipers could have come, is 150 miles away and the main Hawaiian group is about 300 miles distant. No mention of this island has been found in Hawaiian myths or legends.

While practically all the islands visited were uninhabited, they were found to be exceedingly rich in birds. They form what is known as the Hawaiian Bird Reservation. Sandpipers, curlews and golden plover, birds which breed in Alaska and the Arctic regions, were seen in numbers and much knowledge was gained in regard to the habits of these remarkable long-distance migrants.

Donald R. Dickey, motion-picture expert with the expedition, secured many reels which reveal the strange habits of some of the oceanic birds. On Laysan Island he secured pictures of the "dance" of the albatross. These seabirds, as large as geese, engage in this dance in pairs and the dance is continued during the entire eight months the albatrosses are on land. It consists in a regular series of steps and motions in which they advance and retreat, fence with their bills, raise one wing, and similar motions which Dr. Wetmore referred to as the Laysan fox trot.

The birds found on these islands were as tame as domestic chickens. When one of the scientists would sit down to make a few notes, the albatrosses would walk up to him and after apparently satisfying their curiosity, turn and discuss him among themselves.

Johnston Island, the southernmost of the islands of the Territory of Hawaii, and Wake Island, 2,000 miles west, were also visited. Many rare fishes were found and at Johnston Island several unmapped reefs were charted by navy airmen from an airplane carried by the expedition for that purpose. So small and isolated is this last mentioned bit of American territory that Japanese fishermen from Hawaii, who make trips into these waters every year, frequently return to report that they can not find it.

This was the first scientific expedition of the kind in which the navy has taken part since the Wilkes Expedition of 1842.

HORSE CAN EXERT 21 H. P. NEW TEST SHOWS

Science Service

THAT a horse may develop as much as 21 horsepower in an emergency has been demonstrated in a series of experiments conducted by the Horse Association of America with a testing apparatus invented by E. V. Collins, of the engineering department of the Iowa State College of Agriculture and Mechanic Arts, for the purpose of finding out just how much a horse or a mule can pull.

The tests showed a team of good horses can exert a tractive pull of 2,000 pounds, or enough to lift a ton vertically. Such pulls as these are not needed on ordinary roads. It was shown that on a concrete road surface the amount of pull required to start a farm wagon, weighing with its load more than 7,700 pounds, was only 125 pounds.

The influence of the road surface was demonstrated by additional experiments which showed that to start the same load on a good brick road required a pull of 200 pounds, while 300 pounds were required on an asphalt surface and 520 pounds on a good dirt and cinder surface. In other words, the same team can pull four times as much on a concrete road as it can on the best surfaced dirt road.

The new tests emphasized the value of breeding and of training in horses and have opened up new possibilities in the direction of scientific measurement of performance of differing breeds and individuals. While the value of weight in draught animals was again demonstrated, a surprising result of the tests was that gameness counted almost as much. A little broncho team, weighing 455 pounds less than its competitors, pulled larger loads in proportion to weight than any other team entered in the tests in any class. More extended tests will be made next year.

The apparatus consists essentially of suspended

weights attached to a wagon-like vehicle in such a manner that it can not be started until the weights have been lifted. As soon as the horses exert enough power to raise the weights the wheels are unlocked.

DEATHS DUE TO AUTOMOBILES

Science Service

DEATHS from automobile accidents continue to increase while the general death rate among industrial policyholders of the Metropolitan Life Insurance Company declined to nearly the lowest August figure ever recorded, according to the summary for that month just compiled by Dr. Louis I. Dublin, statistician.

Deaths among the insured due to automobiles were at the rate of 18.4 per 100,000 as compared with a figure of 15.4 for the same month last year. Fatal accidents of all classes also showed an increase, the death rate from this general cause amounting to 73.8 per 100,000 as compared with 67.2 in August, 1922.

The death rate as a whole among the insured was the lowest for any month of the year and the lowest August death rate ever recorded among this group of insured, except for the figure for August, 1919. The rate this year was 7.7 per 1,000 as against 7.6 in the former year.

If these figures are representative of the general population a person now is in much more danger of being killed by an accident than of dying from either cerebral hemorrhage or Bright's disease. The mortality rates of these two important causes of death sank last month to 47.5 and 58.3 per 100,000 policyholders, respectively, the lowest figure ever recorded for these diseases in any month among this important group of the population.

LIGHTNING STROKE

Science Service

DEATH from a lightning stroke may not be as painless as has been supposed, if the experience of M. L. McQueen, instructor at the University of Wisconsin, who was struck and recovered, is typical. The incident occurred this summer and has just been reported in detail to the U. S. Weather Bureau by Eric R. Miller, meteorologist in charge of the Madison, Wis., office.

McQueen was walking across an open lot in company with another instructor, W. E. Armentrout, who was killed by the bolt. McQueen remained conscious throughout his experience and fully realized what was happening to him. Relating it some days afterwards he said the pain from the spasmodic contractions of his muscles was terrible, but was nearly equalled by that due to the terrific heat of the flash and the noise. He also suffered from a sensation of intense pressure in the head.

The current entered his body at the left shoulder, which was seared over an area of four square inches. His leg muscles near the ankles were sprained and wrenched by spasmodic contractions. He was paralyzed from the waist down for several hours and was weeks recovering from the burns and the injury to his muscles.

That iron has little directive effect on lightning is indicated by the fact that a railroad rail lay only 10 feet away from the two men, railway construction work within 30 feet, while within less than 50 yards were a tall crane, wire fences and buildings. An iron smokestack was not much further away in the direction from which the cloud had come.

SEED POTATOES

Science Service

How to make two crops of white potatoes grow where only one grew before has been simplified by a discovery of Professor Joseph T. Rosa, of the University of California. The difficulty in sections where two crops are possible has been that the seed potatoes from the first crop must be seasoned three or four months before planting if they are to sprout readily.

Professor Rosa has found that if the new seed potatoes are cut up in the usual way for planting and then dipped into a weak solution of nitrate of soda for from thirty minutes to an hour a short time before they are put into the ground they will sprout as quickly as seasoned seed. The common fertilizer grade of nitrate of soda can be used at the rate of three and a half pounds to ten gallons of water, and as the solution may be used repeatedly the cost is very small. In an experiment started February 23, 1923, seed potatoes treated by this method came up quickly and gave practically a 100 per cent. stand by April 3, while untreated seed came up much more slowly and did not show a full stand until April 21, nearly three weeks later. It was found that the treatment was useless unless the tubers were cut before dipping in the solution. Besides enabling the potato grower to use his early crop potatoes to plant a fall crop and thus get two crops in one year on the same land, Professor Rosa believes that the new treatment will enable growers to mature their early crop still earlier than at present, and thus get the benefit of the higher prices that usually prevail for early potatoes. It may be entirely possible, he says, to make important potato states like New Jersey, Virginia, the Carolinas, Florida and California independent of the more northern states, from which they usually obtain most of their seed potatoes for planting.

EARTHWORMS LEARNING BY EXPERIENCE

Science Service

EARTHWORMS have memory and may be trained in the way they should go, but their brains are not in their heads but in their abdomens. Professor L. Heck, of the University of Prague, has announced this discovery as the result of experiments with a collection of worms some five hundred in number. They were introduced into a passage shaped like a capital T and carved from a block of wood which was covered with a glass plate so that the movements of the little creatures might be observed. When they came to the junction about half of them turned one way and half the other.

Then it was arranged so that those that took the left-hand passage received a mild but presumably disagreeable electric shock. At first the worms did not know just

SCIENCE

VOL. LVIII OCTOBER 19, 1923 No. 1503

CONTENTS

SCIENCE: A Weekly Journal devoted to the Advancement of Science, edited by J. McKeen Cattell and published every Friday by

THE SCIENCE PRESS

Lancaster, Pa. Garrison, N. Y.
New York City: Grand Central Terminal.

Annual Subscription, $6.00. Single Copies, 15 Cts.

SCIENCE is the official organ of the American Association for the Advancement of Science. Information regarding membership in the association may be secured from the office of the permanent secretary, in the Smithsonian Institution Building, Washington, D. C.

Entered as second-class matter July 18, 1923, at the Post Office at Lancaster, Pa., under the Act of March 3, 1879.

SCIENCE AND SOCIETY

I PROPOSE to-day to compare very briefly the problems of the college graduate of my own time thirty-two years ago and those of the present, and then to point out what seems to me to be the most vital elements which must enter into the solution of the problems which to-day's graduating class will be called upon to face.

I have a very vivid picture of one of America's most constructive statesmen, Senator John Sherman, addressing my own class upon its graduation, and wishing with all his soul that he might be in our shoes.

My generation, said he (and his constructive work covered the fifty years from 1845 to 1895), has had for its great task the preservation of the Union, the assuring to posterity of one unified representative government extending over the whole vast area embraced within the limits of our states and territories, the problem—new in the world's history—of creating the conditions which make it possible to try out democracy on a huge scale. That problem we have solved at an awful expense of money and of human lives. The war for the preservation of the Union is passed, and the process of recovery and reconstruction has been in the main completed. Your problem, young graduates, is to show how well, during the next half-century, you can make that kind of government work in a country three thousand miles one way by two thousand the other.

The half-century since 1891 is now two thirds past, and, if it were fair to shut our eyes to the rest of the world and to take the present situation in the United States as an index of how well we have carried out that task, my generation in America might perhaps look back with a certain complacency upon what it has done so far. Certainly, gauged by the standard of the material prosperity of the average citizen alone, I suppose that it will be generally agreed that in this June, 1923, the United States finds itself better off than any country has ever been at any time in the world's history—considerably better off than it itself was in 1891. Wages have more than doubled since that year, and costs have not yet doubled. The condition of the man at the bottom, whether you consider that man to be the unskilled laborer or the young Ph.D. seeking a job, is better now than it was then, and it is probably immensely better than it has ever been in any preceding period of the world's history. In 1896, after a four-year college course, three years

[1] An address delivered at the Commencement of Stanford University, June 18, 1923.

of work for the Ph.D. degree, and a further year in Germany, I myself obtained a position in physics in the University of Chicago at $800. To-day, under the same circumstances, I might hope to receive from $1,800 to $3,000.

Our intellectual and cultural life has made much progress, too. In 1891 there was very little science in the United States. My friends called me very uncomplimentary names for going in for physics—"The deadest imaginable of subjects." They themselves were going in for that fascinating and at that time new subject of sociology. Since that time the advances in that same dead physics may be said, without a display of too much enthusiasm, to have thrilled the world, while the successes of sociology are more problematical. Physics has opened the eyes of mankind so that it can now see in very truth new worlds—a marvelous world of electrons, already quite well explored, which underlies our former world of atoms and molecules, a world of quanta, not yet well understood, which lies perhaps beyond the ether. And our own country, too, has had a reasonable share in this progress. Also the possibilities that can be seen ahead for further advance, both in knowledge and in physical well being are exceedingly alluring if only stable conditions of society can be maintained so that science can have the opportunity to work out these possibilities.

This amazing progress in science has been reflected in industry too. Since 1891 has come the internal combustion engine which now gives the humblest laborer a car (California has one car for every four and a half inhabitants), the "movie" giving him inexpensive, though as yet perhaps not always wholesome, recreation, the amplifier and the wireless, furnishing the world with a huge nervous system which transmits intelligence practically instantaneously throughout its whole giant frame, the airplane, in which man outsoars the eagle and outspeeds the swift, the X-ray with which he discovers the hidden sources of disease in his body, and antitoxines and antiseptics with which he has already banished forever certain of mankind's most awful plagues.

The discoveries which I myself have seen since my graduation transcend, I think, in both number and in fundamental importance all those which the preceding two hundred years brought forth, and these latter far transcend all those of the preceding five thousand years. Such is the acceleration at which the processes of evolution in human affairs are now going on,—a fact tremendously stimulating or terribly depressing according as one has great faith in man or little.

All these things might have been included in the vision which John Sherman had when he longed to be in our shoes so as to help work out the problems which he saw ahead in a land at peace, prospering under stable republican government and working out its own destiny for the enlightenment, and later, perhaps, for the emulation of other nations not yet free from the domination of Caesars. But what Sherman did not see was that through a vastly more bloody and desperate war than any which his generation had known or even dreamed of, not alone we, the inhabitants of the United States, should be faced in 1923 with the problem of making democracy work on a huge scale, but with us almost every important nation on earth. This problem has now become not merely a national but a world problem—and that, too, before the world was ready for it.

But we can not now go back. The increase in the efficiency of the instruments of destruction has for fifty years been making it harder and harder for any autocrat or oligarchy which gets into control of the machinery of government to be dislodged. Revolution against tyranny can not occur in the future as easily as in the past. Russia to-day, under as fateful a despotism as ever existed anywhere, is a living proof of the disasters which may come to a country which loses self-government, which lets any privileged class whatever, whether represented by a so-called communist like Trotsky, or a "God-ordained" kaiser like Wilhelm II entrench itself in power. With revolution, then, increasingly difficult because of the growth and application of modern science I can see no hope of progress save as society adopts a form of government which permits of progress by *evolution* instead of by revolution, which makes possible the peaceful and gradual replacement of men and policies by new men and new policies when rulers lose their sense of proportion, as men in power are likely to do, and when policies have ceased to be productive of social results. *One of the greatest contributions of science to life is the discovery that progress is in general made by the evolutionary process.* Einstein does not replace Newton; he merely supplements him. *There are no revolutions in science.* In so far as Newtonian mechanics was a body of experimental facts it is eternally true. The whole of Newton is incorporated in Einstein. *Let the revolutionary reformer ponder well that fact.*

The supreme question which the present generation faces is, then, can we make democracy work, not merely for America, but for the world? *Can we replace bullets by ballots?* That question is being asked more searchingly and more fearfully to-day than it was in 1891. The answer to it is to be given in the main by you, young graduates, and by others of like opportunity. *If an affirmative answer is found at all it will be, as I think, because the nations of the earth, including our own, learn to take a more rational, a more objective, a more scientific attitude toward life and all its problems than any of them*

have as yet learned to take. Some wag has said that the anti-evolutionist is opposed to evolution because it never did very much for him. I wish to take that witticism altogether seriously. It is literally true that a good many individuals are still *in the jungle* so far as their method of meeting life's problems, so far as the mainsprings of their conduct are concerned.

For in the jungle ignorance and prejudice and impulse and emotion *must* determine conduct, and *so long as that is the case none other save the law of the jungle is possible.* Man himself is just now emerging from the jungle. It was only a few hundred years ago that he began to try to use the experimental and the objective method, to try to set aside all his prejudices and his preconceptions, to suspend his judgment until he had all the facts before him, to spare no pains to first see all sides of the situation and then to let his reason and his intelligence, instead of his passion and his prejudice, control his decisions. That is called the scientific method. Why? Not because it is applied only in the study of science, but because it has had its most striking development in the sciences, and because it finds its finest application to-day, though not its only one, in the analytical subjects of mathematics, physics, and chemistry. It is because of that method that these sciences have very recently made the astounding strides referred to a moment ago. It is because of it and what it has done already that scientists dare to hope that the law of the jungle can ultimately be displaced by the law of reason, not only in our domestic affairs but in our international ones as well. It is because of it that scientists in general believe that human life may be indefinitely enriched and human happiness enormously multiplied.

But how far are we from the application of that method now, even in our so-called enlightened United States? Let a few illustrations answer. A few weeks ago the daily press reported that the New York legislature had passed a bill requiring that the history of the revolutionary period be taught in the New York schools so as to develop patriotism. The only possible interpretation of that act was that the legislature desired the facts of the revolution to be distorted to suit the prejudices of dwellers in New York. It is fortunate, indeed, that this was the same legislature that has just passed a bill which, whatever its purely legal and technical status, is yet deliberately *aimed at* the nullification within New York State of the present constitution of the United States, since otherwise there would be two such legislatures instead of only one in this country. And yet New York thinks that it is representative at least of the average state of evolution and of intelligence of the country. Let us hope that it is mistaken!

My second illustration, however, is not taken from New York. I recently asked a prominent school book publisher if it would be possible to begin a slow process of eliminating the misunderstandings which lead to war between peoples by inducing publishers of school histories in all countries to submit their proposed school books to three or four international historians of world repute, who would endorse them, if they were able to do so, by the statement that these histories pictured essentially correctly the portions of the field of history with which they dealt. His reply was, "No. It is not yet possible to take such a step in the United States, for the reason that school boards do not yet in this country want history to be taught as it happened. They want something to be called history which pleases their pride and appeals to their prejudices, and I know it because we are ourselves just having our histories attacked in the State of Washington on the ground not that they are incorrect but that they are unpatriotic. And this sort of thing is happening to publishers all over the United States." This means that we are doing in our America to-day precisely what the whole world condemned Germany for doing in all the years preceding 1914, namely, *teaching nationalism in preference to truth.*

The American newspaper which claims to have the largest circulation of any newspaper in the world displays as its motto the words of Stephen Decatur completely inexcusable, at least as they are usually understood, "Our country! May she always be right, but our country right or wrong." It was in very fact the international hates and misunderstandings caused by just that sort of teaching which brought on the great war. And yet there are a dozen American newspapers which are sedulously spreading not merely anti-British but anti-international propaganda of every description.

A British visitor who has traveled and lived in this country recently told me that if his analysis were correct the United States was more likely to start another war than was any nation of Europe. But if another such war as the last is started, I, for one, fear that the world may bid good-by to civilization. I am far from being a pessimist, but the history of central Asia, once at the center of the earth's civilization, and again, the very recent history of Russia, both show that it is possible to destroy civilization completely in a very few years of time. *Let those who deliberately set to work by distortion and untruth, by misrepresentation and cynical mistrust of motives, to stir up class hates and class prejudices in America, reflect well upon these things.* Some of them do it from base motives, because the mob has votes or pennies; others have good enough intentions but neither the intelligence nor the training to catch the scientific spirit and to be able, or even to try, to distinguish truth from falsehood. Well meaning men without poise or any sort of scientific discrimination, and highly trained

and able men without conscience are about equally grave dangers to the wholesome development of human society.

Another glaring example. Look at the storm of protest raised in the United States Senate when Mr. Harding proposed that we begin to try to establish a machinery for settling judicially our international difficulties by joining the Hague court of international justice, a body organized largely through the genius of our own Mr. Elihu Root, and then ask yourself whether that protest was dictated by ignorance and prejudice or by intelligence and the scientific spirit.

But we do not need to go to Washington, to Chicago, or to New York, nor even to the field of politics for all our illustrations. We have, indeed, not yet passed anti-evolution laws in California, but we have many people even here who hasten to condemn evolution without having the remotest conception of what it is that they are condemning, nor the slightest interest in an objective study *of the evidence in the case which is all that "the teaching of evolution" means,* men whose decisions have been formed, as are all decisions in the jungle, by instinct, by impulse, by inherited loves and hates, instead of by reason. Such people may be amiable and lovable, just as is any house dog, but they are a menace to democracy and to civilization because ignorance and the designing men who fatten upon it control their votes and their influence. The churches are often charged by their critics with having more than their share of this type of jungle dwellers, but my own observation is that there are almost as many within the churches who have caught the scientific spirit as there are among the so-called scientists themselves, and many more who have caught what is even more essential to progress, the altruistic spirit. Medical science certainly is full of the jungle dwellers, as is shown by the existence of such a scientific anomaly as sects in medicine. *For science is an objective study of the facts of nature.* It uses any and all hypotheses which assist in correlating these facts, and its many hypotheses have had varying degrees of success in making such correlations, but science never commits itself as a matter of faith to any of them, not even to evolution. When it does so it ceases to be science.

But what, now, is the remedy? Is there any hope for the improvement of the situation and the elimination of the dangers which threaten the permanence and success of our modern society inside our commonwealth and outside of it? I have no nostrums to propose. The longer one lives the less confidence does he have in any universal formula. The situation itself which I have portrayed suggests the only solution which there can be, namely, the slow growth of a larger degree of *both public intelligence and public conscience than we now have. Intelligence enables one to know better what he ought to do, while conscience keeps him doing as he knows he ought.* In America the school has concerned itself primarily with the first field, the church with the second. Which will play the larger rôle in getting us out of the jungle I will not attempt to say, but it appears to me fairly obvious that without both of them human society is headed for the rocks. But science, imbued with the spirit of service, which is the essence of religion, and religion guided by the intelligence, the intellectual honesty, the objectiveness, and the effectiveness which is characteristic of the spirit of science, can between them, without a shadow of a doubt, in view of the rate at which discoveries are now being made and at which changes are being brought about, transform this world in a generation. If that transformation actually gets very far in your lifetime, members of the class of 1923, it will be because of the following sorts of influences:

First, it will be because you graduates, and others of your opportunities, act as centers for the growth in the communities in which you live of both the scientific spirit and the altruistic spirit, and a relatively few such centers can accomplish wonders, for most men follow while but few men lead. It will be because you do not sit idly and thoughtlessly by expecting that leadership to come from New York or Chicago or other great centers of population. Remember that Athens, with its hundred thousand Greeks, did more to shape the development of the race than any city of fifty times its population has ever done, and that an insignificant village in Galilee did more than Athens. The only way in which public sentiment, the sovereign power in a democracy, can be developed is by having hundreds and thousands of such centers as you may yourselves create in the communities in which you live. There is nothing new nor spectacular about that remedy any more than there is about any of the processes of growth, but these are, after all, the processes by which most of the progress of this world comes about.

Secondly, I think that you or some one else, will soon take steps to so reorganize the teaching of science in the public schools as to give a larger fraction of the pupils who go through our high schools and colleges more training, particularly in the mathematical and physical sciences, for from my point of view there is no training in objective, analytical thinking, nor in honesty and soundness of judgment, which is comparable to the training furnished by these sciences. I know of no training for life which is equal to it, whether one is to be an engineer, lawyer, business man, or preacher. It is an exceedingly wholesome thing to work at some time in one's life in a field in which *the distinction between right and wrong,* be-

tween loose and correct thinking, can not be obliterated or escaped; to learn that there are eternal physical laws and presumably also eternal æsthetic, moral, and social laws in conformity with which one must proceed if he is to arrive at correct results; to learn, too, that four fifths of all the experiments which we make in our physical laboratories in the hope of developing new relations, establishing new laws, or opening up new avenues of progress, are found to be directed along wrong lines and have to be abandoned. There is no reason to suppose that any larger percentage of the efforts which are made toward social, political, or educational reforms are in the actual direction of progress. With a better realization of these facts we should have less worship of the new *merely because it is new*, fewer cubists in art, in literature, in education, in politics, in social reform. One of the well-known residents of Southern California who had a fine training in physics and mathematics but has spent his later life as a farmer and fruit grower said to me the other day, "I do not use my science much on my ranch. I guess and blindly follow tradition almost as much as my neighbors, but I know *when I don't know* and they do not. That is worth all my education cost me." If such a change in our public school curriculum as I am suggesting is brought about at all, it is going to be done, I think, through a reorganization of the required group of studies rather than by important changes in methods of instruction in the individual sciences. This is primarily a matter of the public schools.

In the third place, public spirited men are going to see more and more that the support in a large way of scientific research is an investment which brings the largest returns of satisfaction to themselves and of progress to mankind which can be made at all. It is my own belief that no efforts toward social readjustments or toward the redistribution of wealth, such as so many well meaning people are urging in a thousand different ways, have one tenth part as good a chance of contributing to human well being as have the efforts of the physicists, the chemists, the biologists, and the engineers toward the better understanding and the better control of nature. The distribution of wealth can, of course, be improved, and I welcome every constructive and sane effort toward its improvement, but the results which can be accomplished for the well being of mankind by efforts in this direction seem to me to be utterly trivial in comparison with those which may be brought about by physical and biological research. An eminent and progressive economist told me lately that no sort of redistribution of the wealth now available could possibly add more than ten per cent. to the income of the average man, and probably much less than that. To replace for the toiler a dollar meal by a dollar and ten cent meal is scarcely my idea of the millennium.

In the fourth place—and this is in my opinion most important of all—*the spirit of religion and the spirit of science are going to join hands*, because the leaders of both religion and of science are coming increasingly to see life as a whole instead of from the pathetically narrow and unscientific point of view from which some in both fields have in the past looked upon it. This is one of the places at which you young graduates have your greatest opportunity to exert a very large influence upon your generation.

I should like, in closing, to call the attention of any man who is wondering whether after all there is any progress, whether mankind gets farther away from the method of the jungle, and develops any more of the spirit of science, or of the spirit of service than he had in the past, to two recent events. Both of these events seem small, but I think they are pregnant with meaning and with encouragement for the man who has begun to wonder whether human society can ever really catch both the *scientific spirit and the altruistic spirit* and realize the immense possibilities which are before it when it does.

My first event is in the field of medical education. I am informed by my medical friends that the medical fraternity has actually educated itself up to the point where allopaths and homeopaths have got together, to abolish, so far as they themselves are concerned, sectarian schools of medicine. The last of these particular sectarian schools, so I am told, has gone, having been simply and rationally combined into schools which teach merely *medical science* as it is known today. Truly "the thoughts of men *are* widened with the process of the suns!"

The second ground for encouragement is found in the following fact: A statement upon the relations of science and religion was recently drawn up, which Bishop Johnson of Los Angeles characterized as a "thoroughly pious statement." It asserted that religion and science were not only not antagonistic, but that both were necessary to the progress and the happiness of mankind. Further, this statement definitely recognized God, for whom I myself want no better definition than that given by Tennyson when he wrote, "For I doubt not through the ages one increasing purpose runs," and it definitely assigned to religion an even more important place in human life than to science. On the other hand, it called for the recognition by all the signers of the scientific method. *Fifteen sixteenths of all the scientists to whom that statement was submitted signed it at once without a question as the statement of their belief*, and these men were chosen, let it be remembered, solely because of their outstanding character as scientists and with-

out any knowledge of their religious views. Three fourths of all the men of affairs approached signed and none expressed dissent, a few, however, preferring for political reasons not to join in the statement. Two thirds of the religious leaders who were interrogated signed, most of whom were of the more conservative groups. The response of the scientists is particularly significant and possibly has some bearing upon the breadth of view developed by scientific training. After this showing who is he who is asserting that science is materialistic and irreligious? There are a few scientists, it is true, but only a few, who forget the scientific method when they touch the field of religion and scoff at it without knowing anything about it, and these men, too, have their exact counterparts, perhaps in slightly larger numbers, in the field of religion where there is, I regret to say, a group of blind leaders of the blind, men who still follow the method of the jungle and are still imbued with its spirit of prejudice, preconception and intolerance. Yet there is here the best of evidence that the leadership in both science and religion is in the main imbued with both the spirit of intellectual honesty and objectiveness which is characteristic of science, and the spirit of altruism and service which is the glory of religion. *This combination is the only nostrum which there is for human ills, the only hope for a paradise on earth, and each of us has the opportunity to do his bit toward bringing it about.*

R. A. Millikan

Norman Bridge Laboratory of Physics,
California Institute of Technology,
Pasadena, California

THE BUILDING OF THE NATIONAL ACADEMY OF SCIENCES[1]

The architectural character of the building has been largely determined by its surroundings, being what Charles Moore calls the "Spirit of Washington." While classic in its appearance, it is not severely formal and lacks the rows of columns so familiar to the visitor to the National Capital.

The general character of the exterior is Greek even to the varying of the height of the masonry courses.

Across the doorway is a marble pseudo-pediment, wherein the sculptor has portrayed the elements with which science and scientific research deal—Earth and Cloud through the various forms of the Vegetable and Animal Kingdom to Man. At the apex is the Sun—the source of warmth and light.

A great range of window openings two stories in height, three each side of the entrance, is filled between the upper and lower windows with low relief bronze panels figuring the outstanding Founders of Science from earliest times.

Within the main doorway lies a simple vestibule from which the great Foyer Hall is entered. At the beginning and end of this hall are elaborate grilled glass screens with panels of the Zodiacal signs set in an intricate framework of bronze. The ceiling is of cedar—colored and gilt. On either side of the hall are staircases and elevators. On the left beyond these is the library, and still further beyond, its attendant reading room occupying the very end of the building.

In the right wing of the building balancing the library is the small Lecture Hall, and beyond it the Meeting Room. The library takes the form of a central aisle with alcoves on either end. All here is of masonry and metal, even to the bookshelves.

The Reading Room is of more domestic appointment, panelled in walnut for about two thirds of its height, with a ceiling of walnut. The space between is now of plaster but may eventually be filled with a painted frieze.

The small Lecture Hall has been designed mainly with a view to its acoustic qualities. Above the high wainscoting of wood and panel, the wall is of acoustic tile. The ceiling and its heavy beams are of plaster.

The Meeting Room next to the Lecture Room is of the same size and proportion as its counterpart, the Reading Room at the extreme other end of the building, but it is less domestic in character on account of its purpose. As in the Library and Reading Room there is an ample fireplace.

The second screen in the Foyer Hall leads into the main Auditorium, which is cruciform in shape, the four arms being vaulted to support a central pendentive dome. The floor is of marble and green slate and three balcony fronts, each supported by two shafts of Verde antique marble, are of walnut with various inlays of other wood. The walls to the center of the arches are of acoustic tile and are as simple as possible in character and surface.

Above the spring, the arches and dome are genuinely vaulted and covered with acoustic tile, in its turn covered with elaborate decoration with panels of figures and emblems, the whole colored and gilt.

In the apex of the dome is an "eye," which is an accomplishment of scientific engineering. The roof of this "eye" swings upon itself in a way that permits the direct rays of the sun to enter at all periods of the year and day, and be projected to a spectrograph at the level of the floor under the dome. From this "eye" also depends a Foucault pendulum to demonstrate the rotation of the earth.

Both pendulum and spectrograph are removable

[1] Abstract of a memorandum to the Carnegie Corporation of New York on the building designed by Bertram G. Goodhue for the National Academy of Sciences and the National Research Council, and the progress of its construction.

when occasion demands. The support of the spectrograph is bronze covered with figures of Sun gods in low relief. In this room under the dome, which constitutes the Main Auditorium, again there are motion picture booths with a screen provided behind the Speaker's Tribune.

Around the central auditorium lie seven exhibition rooms, three large and four small, to put promptly before the public important current discoveries and inventions in Science. These rooms are very simple in their character but each one has been carefully studied for the purpose to which it is to be put.

Besides the various workaday offices in the second and third floors for the National Academy of Sciences and the ten divisions of the National Research Council, the basement contains a large two-story stack room for the library, as well as certain public exhibition rooms from which daylight must be excluded.

The general contract was let on April 11, 1922, to Charles T. Wills, Inc.

Prior to the letting, the exploratory work encountered difficulties in the foundations, increasing the cost in the neighborhood of $50,000, due to an ancient stream bed covered up when the land—which is made land—was filled in many years ago.

The foundation walls rest on reinforced concrete girders, which in turn rest on 74 concrete piers five feet square to bed rock and the girders supporting the terrace rest upon 33 large steel tubes driven to bed rock, emptied and filled with cement.

The dome over the Rotunda is rapidly rising.

In general the project is about 75 per cent. completed. Nothing has been started on the grading of the site for carrying out the plans for the grounds, which involve a main approach with side approaches, reflecting pools and other landscape features.

Through the efforts of the National Academy of Sciences, Congress was induced to close Upper Water Street, adding the area of this street to the Academy-Research Council quadrangle, which because of this now comprises the whole area enclosed between B and C Streets, from 21st to 22nd Streets, and in effect becomes part of the park in which the Lincoln Memorial stands.

Out of the $1,350,000 appropriated for construction by the Carnegie Corporation, $713,128.37 has been spent. Prospective and actual over-runs in cost amounting to $55,656 beyond the original estimate, due to rising costs and unforeseen contingencies, have been encountered, but in an effort to compensate for these, prospective savings and reduction of scope amounting to $42,876 have been made.

The period has been one of rapidly rising costs produced by nation-wide congestion in the labor and material markets. The main contract could not be re-let now for less than $250,000 more.

The land purchased by the National Academy of Sciences through funds amounting to $185,000, raised by subscription, is in a most favorable location opposite one face of the Lincoln Memorial, with which the white marble Greek style of the Academy-Research Council building is in harmony.

The building is attracting unusual attention and its advent will signalize a very important step in the development of science in the United States.

Gano Dunn

Chairman, Joint Building Committee, National Academy of Sciences, National Research Council

CHARLES NEWTON LITTLE

Professor Little, dean of the college of engineering in the University of Idaho, passed away suddenly from heart failure in Berkeley, California, on September 7.

He was born of missionary parentage at Madura, India, in 1865. He was a graduate of the University of Nebraska, where he took the A.B. degree in 1879 and the M.A. degree in 1884. He took his degree of Ph.D. at Yale in 1885 and afterward studied in Germany with Klein and Hilbert. His work in the theory of knots was of fundamental importance. By methods which he invented and perfected he succeeded in enumerating and classifying the different kinds of knots up to those of the tenth order. This work attracted the attention and interest of Professor Tait, of the University of Edinburgh. Professor Little's work was published in the *Proceedings* of the Connecticut Academy of Sciences and in the *Transactions* of the Royal Society of Edinburgh. In the last few weeks of his life, on being relieved of his duties as dean of the college of engineering, he turned again to these researches and under the inspiration of sympathetic associates he was laying his plans for another assault on this most difficult field of analysis situs. His untimely death is a very serious loss to mathematics.

As a teacher he may be known by his fruits. He was ever vigilant in the upholding of high standards of scholarship. Earnest and enthusiastic and inspiring, inflexibly following his own high ideals, he was a man to be reckoned with by those who would take the easy and popular roads in educational matters. As a man, he was entirely lovable. Loyal to his friends, with malice toward none of those who failed to understand his devotion to what he believed was right, he has left behind him an imperishable record of a well-spent life.

D. N. Lehmer

SCIENTIFIC EVENTS

THE INTERNATIONAL HEALTH BOARD OF THE ROCKEFELLER FOUNDATION

Sections of the report of the International Health Board of the Rockefeller Foundation for 1922, made public in advance of the general distribution of the volume, show that during the year the board worked in cooperation with the governments of seventy states and countries throughout the world.

The activities reported include a review of the history and objects of the International Health Board; the campaign against yellow fever in Mexico and South America; surveys, field experiments and demonstrations in malaria control at home and abroad; world-wide efforts in the control of hookworm disease; the extension of county health work in the United States and Brazil; the development of public health laboratory services, public health nursing services, and schools of hygiene in various countries; cooperation with the health section of the League of Nations; and the extension of training through fellowships.

The International Health Board had its inception in an organization known as the Rockefeller Sanitary Commission, established by Mr. John D. Rockefeller in 1909, which in 1913 was supplanted by the International Health Board, created by the newly organized Rockefeller Foundation with the immediate object of extending "to other countries and peoples the work of eradicating hookworm disease as opportunity offers, and so far as possible to follow up the treatment and cure of this disease with the establishment of agencies for the promotion of public sanitation and the spread of the knowledge of scientific medicine."

Reviewing briefly the activities of the board since 1913, the report points out in the following paragraphs the fundamental principles on which its work has been based.

In the course of almost ten years of cooperative service with government authorities, hookworm infection the world over has been measurably diminished; progress has been made toward reducing the ravages of malaria; and a relentless campaign is still being waged against yellow fever wherever its danger flag appears. From the outset, however, the board has maintained the conviction that public health is essentially a function of government. No private and temporary agency, whatever its resources, could or should discharge responsibilities which, by their nature, belong to the constituted authorities of the commonwealth. Private enterprise, therefore, may be best employed in awakening public opinion and thereby encouraging state and county officials to establish permanent agencies for public health work. Responsibility for the control and cure of any one disease has never been assumed by the board; but aid has been given in control and cure where such steps might be expected to demonstrate a need and suggest a possible program.

Lastly, it has been clearly recognized that continued advance in preventive medicine the world over depends upon an adequate supply of skilled public health servants. Research has been aided in special cases where it might lead to the more effective application of existing knowledge to the control of disease. Training schools for health officers, nurses and visitors have been promoted; contributions have been made toward the establishment of schools of public hygiene. And finally, the fruits of these enterprises have been made accessible to a broader circle by means of international fellowships.

The demonstration and cure of disease arouses a public sentiment which expresses itself in legislative appropriations for specific and general health purposes. Progress on the administrative side, in turn, creates a demand for technically trained men and women to carry out new programs. Thus public enlightenment, government machinery and technical education and research are bound up in a sure sequence which may be traced in some of the activities of the board during 1922.

EXPLOSION AT THE BUREAU OF STANDARDS

The *Journal* of the Washington Academy of Sciences gives the following account of the explosion at the Bureau of Standards:

On the afternoon of September 20 a violent explosion followed by fire occurred in the Dynamometer Laboratory of the Bureau of Standards. One man was killed instantly, three others injured so seriously that they died during the night, and four others seriously burned or cut. The heroism of the survivors of the staff in rescuing the injured from the furiously burning wreckage and in shutting off the electric circuits and the ammonia valves minimized the loss of life and property.

The explosion occurred in the altitude chamber which is used in testing the performance of aircraft engines under the conditions of low pressure and temperature obtaining at high altitudes. At the time of the accident the room was being used in investigating the performance of an automobile engine, at temperatures corresponding to winter operation, using various grades of gasoline. The work was intended to determine the possible increase in gasoline production per barrel of crude oil, with the accompanying conservation of our national resources, by the use of gasoline of lower volatility.

The explosion was due to the ignition of an explosive mixture in the chamber.

The dead are: Logan L. Lauer, Urban J. Cook, Stephen N. Lee, Joseph Kendig. The injured are: Henry K. Cummings, Frank E. Richardson, Roger Birdsell, George W. Elliott, C. N. Smith, R. F. Kohr.

Most of these men were college graduates with experience and skill in research work, and a grave blow to science and engineering must be added to the human loss to their families and colleagues. Thus grows the long list of those who have given their lives for the increase of human knowledge and welfare.

THE ALDRICH COLLECTION OF DIPTERA

THE National Museum has recently received as a gift from Dr. J. M. Aldrich his private collection of Diptera. This collection was begun in 1890, and for 28 years received a good share of the owner's efforts; since he went to the National Museum in 1918 it has, however, received no additions. A recent inventory showed it to contain 44,610 pinned specimens and 4,145 species fully named; 534 of the latter were represented by type material. There are some hundreds of undescribed species; and as Dr. Aldrich collected for many years in the Pacific Coast and Rocky Mountain regions, his collection contains many named species not heretofore represented in the National collection.

Dr. Aldrich also donated to the museum his card index of the literature of North American Diptera, begun in 1898 and now extending to about 70,000 references as nearly as can be estimated. With the exception of about 20 hours' work, this is all by the hand of the owner himself, and represents to a large extent his own conclusions from the literature rather than a mere compilation.

In a letter to his chief presenting the collection and index, Dr. Aldrich states that he was deterred from taking this action sooner because the salaries paid by the museum are still on the scale established in 1882 (except for a temporary war bonus of $240), and he did not feel sure that he could continue permanently as one of the curators. Recently, however, under the reclassification act passed by the last congress, the museum staff have been assured of a new pay schedule approximating the requirements of the present time.

HARVARD COLLEGE OBSERVATORY

THE Harvard College Observatory, entrances on Concord Avenue opposite Buckingham Street and on Garden Street opposite Linnaean Street, will be open to visitors from 7:30 P. M. to 9 P. M. on the dates given below.

A short talk, generally by a member of the observatory staff, will be preceded, when the weather permits, by telescopic observations of celestial objects. Exhibits showing the work of the observatory will be explained by members of the staff.

Tickets for the open nights must be obtained in advance by writing to the Harvard College Observatory, or telephoning University 0390 between 9 and 11 A. M. There is no charge for admission. Applicants will be assigned tickets for one night only.

The dates, titles of lectures and speakers are as follows:

Monday, October 29—"Eclipses of sun and moon," Professor H. T. Stetson, Harvard University.

Wednesday, November 14—"The variation of stars," Mr. Leon Campbell.

Tuesday, November 27—"Stellar motions," Dr. Willem J. Luyten.

Wednesday, December 5—"The origin of the earth," Professor Harlow Shapley.

Thursday, December 13—"Ancient and modern telescopes," Professor Edward S. King.

Friday, January 11—"Nebulae," Professor John C. Duncan, Wellesley College.

Thursday, January 31—"Harvard observatories in Chile and Peru," Professor Solon I. Bailey.

CELEBRATION IN HONOR OF PROFESSOR E. H. S. BAILEY

DR. EDGAR HENRY SUMMERFIELD BAILEY, professor of chemistry at the University of Kansas, was signally honored on September 21, when the University of Kansas, the Kansas Academy of Science and the Kansas City Section of the American Chemical Society joined with the Department of Chemistry of the University in an anniversary celebration which marked the completion of his fortieth year of service at the university. It was not only the unique distinction of having served one institution for four decades that inspired this celebration, but also the fact that during these four decades Professor Bailey has enriched the science of chemistry by the publication of some one hundred papers, largely the results of his own researches, and the publication of several books of recognized scientific value, and also as director of the chemical laboratories, has built up a strong department which has turned out many men who have attained distinction in their special fields. Many of these men returned on this occasion to honor Professor Bailey, and many who could not come sent congratulatory messages.

The afternoon program consisted of two addresses by former students of Professor Bailey: Dr. E. C. Franklin, president of the American Chemical Society, who spoke on "Systems of Acids, Bases and Salts," and Dr. E. V. McCollum, professor of biochemistry at Johns Hopkins University, whose topic was "The Present Status of our Knowledge of Nutrition."

In the evening, at a banquet attended by two hundred, appreciation of Professor Bailey's kindly disposition, efficient service and lasting contributions was voiced by speakers representing the organizations in which he has been most active. Dr. Frank Strong, ex-chancellor of the University of Kansas, acted as toastmaster on this occasion. The Honorable D. O. McCray, representing the governor, spoke for the State of Kansas, Chancellor E. H. Lindley for the University, Dr. E. C. Franklin for the American Chemical Society, Dr. J. T. Willard for the Kansas Academy of Science, Dr. E. V. McCollum for the

Alumni, Dr. H. P. Cady for the Department of Chemistry, Professor Sidney Calvert for the University of Missouri, and Harold Greider, representing Director E. R. Weidlein, for the Mellon Institute. Professor Bailey spoke in response to the presentation of an appropriately engraved silver vase, which was made to him in the name of his colleagues and former students.

G. W. S.

SCIENTIFIC NOTES AND NEWS

THE local committee for the meeting of the National Academy of Sciences, to be held at Cornell University from November 12 to 14, consists of Professors Edward L. Nichols, *chairman;* Ernest Merritt, L. H. Bailey and W. D. Bancroft. A business session of the academy will be held on Monday morning, November 12. An open meeting immediately afterwards will begin with a brief address of welcome by President Farrand. The afternoon has been left open for informal gatherings of the members, inspection of buildings, sightseeing or other recreation. It is proposed to arrange a public lecture for the evening. Meetings for the presentation of papers will be held in the morning and the afternoon of Tuesday. President and Mrs. Farrand will receive the visiting members and their friends at the president's house from 4:30 till 6 P. M. A dinner will be held in the evening. A morning session is planned for the presentation of papers on Wednesday.

ON the occasion of the dedication of the Jesse Laboratory of Chemistry at Brown University on October 10, the degree of doctor of science was conferred on Professor James W. McBain, of the University of Bristol, who made the principal address. The degree of doctor of laws was conferred on President James R. Angell, of Yale University. Secretary of State Charles E. Hughes made the chief address at the dinner.

A MEMORIAL service for the late Dr. Henry Marion Howe, the distinguished metallurgist, for many years professor at Columbia University, will be held at the Cathedral of St. John the Divine at 5 P. M. on October 25. Among the speakers will be Professor M. I. Pupin, of Columbia University.

IN addition to giving the Silliman lectures at Yale University, Dr. Niels Bohr, professor of physics in the University of Copenhagen, is giving the Simpson lectures at Amherst College.

G. F. LOUGHLIN has been made acting chief of the section of metalliferous deposits, division of geology, in the U. S. Geological Survey.

WILLIAM B. HILL has been elected president of the board of trustees of the Hoagland Laboratory of Brooklyn, said to be "the first laboratory in this country to have been built and privately endowed for bacteriological research and the advancement of medical science."

COLONEL CHARLES KELLER, of the Corps of Engineers, has been retired from active duty in the army after more than thirty-seven years of service. He is now engaged in the solution of engineering problems in connection with waterpower development on the Pit River in California.

PROFESSOR EUGENE E. HASKELL, formerly dean of the College of Civil Engineering of Cornell University, who has more recently been emeritus professor of experimental hydraulics, left Ithaca on August 20, with Mrs. Haskell, for Hamburg, New York, where they will make their home. Dean Haskell has retired from active engineering duties, but will occupy himself in a consulting capacity in his profession with Buffalo associates.

WILLIAM B. PLUMMER, formerly research chemist for the Grasselli Chemical Company, is now associated in the same capacity with the Combustion Utilities Corporation, Long Island City, N. Y.

RICHARD FISHER, formerly of the chemistry department of the University of Illinois, has accepted a position as research chemist with the same company.

DR. L. EMMETT HOLT has been assigned as visiting professor of pediatrics to the Peking (China) Union Medical College, by the Rockefeller Foundation. Dr. Holt, who is on his way to the Orient, will conduct a three months' series of lectures. He will also make a survey of child health methods as practiced in various countries and plans to return to New York next summer.

DR. LEE DE FOREST returned from Europe on October 1, on board the French liner *Paris*. Dr. de Forest brought with him a device known as the oscillating audion which he said would greatly facilitate broadcasting.

PROFESSOR R. C. GIBBS, professor of physics at Cornell University, will spend the coming year on sabbatic leave as an associate in the research department at the California Institute of Technology at Pasadena.

AT the recent centenary of the Royal Asiatic Society held in London, Professor James H. Breasted represented the University of Chicago and Professor Albert T. Clay of Yale University.

DEAN R. L. SACKETT, of the school of engineering at the Pennsylvania State College, is visiting technical colleges and universities in Europe.

Mr. F. W. Taylor is engaged in the work of starting several agricultural experiment stations for the government of Salvador, Central America. He may be addressed in care of the American Legation at San Salvador.

Dr. Walter R. Bloor, of the School of Medicine and Dentistry of the University of Rochester, will deliver the second Harvey Society Lecture at the New York Academy of Medicine, on Saturday evening, November 3. His subject will be "The utilization of fat in the animal body."

Dr. Calatayud Costa, professor of electrology and radiology of the University of Madrid, has been invited to lecture at the Battle Creek Sanitarium and at certain universities in this country.

The death is announced of Professor Tomasso Salvadori, of Turin, known for his work in ornithology.

Mr. John D. Rockefeller, Jr., has given $500,000 toward the endowment fund of $2,000,000 of the New York Zoological Society and will contribute $500,000 more as soon as the society raises another million. Mr. Edward S. Harkness has subscribed $100,000 and the estate of Mrs. Frederic Ferris Thompson $50,000. For some time the society has been carrying educational, philanthropic and civic burdens far beyond its financial resources. Mr. Rockefeller's gift is without restrictions and its income becomes immediately available.

F. J. Willson, a member of the board of commissioners of Cook County, and chairman of the county committee on a zoological park for Chicago, reports that as approved by the legislature, the county is prepared to submit to the voters in November a proposed tax of $500,000 a year for five years and $250,000 a year annually thereafter. The larger sum is to equip the Zoological Park, the smaller to maintain it after it is established. Land for the proposed park at Riverside in the Cook County Forest Preserves, where the animals will be exhibited on a plan which will allow them to roam free, instead of confined in cages, was a gift to the county board for the purpose. Recently the board signed a twenty-five year contract which turns over the management to the Chicago Zoological Society.

The Society of Chemical Industry will meet in Paris from October 20 to 25. It will be particularly devoted to the agricultural applications of chemistry.

The sixtieth anniversary of the founding of the Entomological Society of Ontario will be celebrated by a series of meetings to be held in Ottawa on November 1, 2 and 3.

We learn from *Nature* that the International Commission of Eugenics met at Lund in Sweden on September 1 and 3 under the chairmanship of Major Leonard Darwin. Various resolutions were passed, and the question where the next international congress should be held was discussed. Professors Nilsson-Ehle and Johansson were appointed members of the commission. The commission was entertained at dinner by the Mendelian Society and visited the Swedish Institute of Genetics at Akarp, near Lund, and the Swedish State Institute for Race Biological Investigation. These are the only institutions in the world for genetics or eugenics which are state-endowed.

The sixth annual joint convention of the American Sections of the Science Society of China and the Chinese Engineering Society was held at Brown University, Providence, R. I., from September 7 to 15, inclusive. Seventeen papers were presented at the forum meeting and the technical sessions. Most of these papers will be published in "Science" (Chinese), the official organ of the Science Society of China. Among the papers were "Some Theories in Combinatory Analysis," by C. J. Chin, of the University of Chicago; "The Effect of Hydrostatic Pressure on the Magnetic Permeability of Iron, Cobalt and Nickel," by C. S. Yeh, of Harvard University; "Production of Non-Corrosive Alloys," by E. C. Y. Cheng, of Columbia University. These papers will probably appear in *American Journal of Mathematics*, *Physical Review* and the *Journal of American Electro-chemical Society*, respectively. The speakers of the convention included Mr. J. R. Freeman, ex-president of the American Society of Mechanical Engineers and the American Society of Chemical Engineers; Professor Harold B. Smith, director of Electrical Engineering Department of Worcester Polytechnic Institute, and Dr. J. A. L. Waddell, consulting engineer.

The next meeting of the American Electrochemical Society will take place April 24, 25 and 26, 1924, in Philadelphia, with headquarters at the Bellevue-Stratford. The principal attractions of the technical program will be the two Symposia, as follows: "Recent progress in electrodeposition," S. Skowronski, research chemist, Raritan Copper Works, Perth Amboy, N. J., *chairman*, and "Organic electrochemistry," C. J. Thatcher, chemical engineer and electrochemist, New York City, *chairman*.

A party of British medical students has recently completed a Continental tour under the auspices of the National Union of Students of Great Britain, a body affiliated to the International Confederation of Students. The party comprised members of the Universities of Oxford, London, Manchester, Liverpool, Leeds, Edinburgh and Glasgow; and the medical centers visited included Paris, Brussels, Vienna, Prague, Berlin, Munich, Leyden and Zürich.

APPOINTMENT of an unpaid commission to supervise the organization of medical research workers was recommended by M. Douglas Flattery, of Boston, chairman of the special committee on medical research, during a conference with President Coolidge on October 9. Mr. Flattery also recommended the enactment of legislation for a national study of preventive medicine. This is in line with a recommendation made to President Harding about two years ago, which was discussed and approved by the cabinet. At that time President Harding referred the matter to Brigadier General Sawyer, his personal physician, to make such other recommendations as might seem suitable to him. The plan included the organization of all scientific workers in such colleges and laboratories as have laboratory equipment together with chemists, physicists, biologists, bacteriologists, physiologists and other scientific men working in related fields.

UNIVERSITY AND EDUCATIONAL NOTES

SUIT was filed in the circuit court on October 1, asking approval of the plans to raze the old Rush Medical College buildings at Harrison and Wood Streets, and to erect a $400,000 building to be known as the Rawson Clinical Laboratories, for which Frederick H. Rawson donated the sum of $300,000. The University of Chicago, according to the plan, will take over the property and build the new laboratory. A contract between the college and the university has been tentatively adopted, pending the approval of the court. A program which provides for the expenditure of $5,300,000, gifts to the university for the advancement of medical education, is to be carried out, the bill states, and includes the building of a hospital of 200 beds on the university campus.

THE president of Cuba has issued an order establishing a university governing assembly. It is to consist of thirty professors, thirty alumni and thirty students, and this body will have charge of the management of the university.

DR. WILLIAM M. MARRIOTT, chief of the department of diseases of children, Washington University Medical School, St. Louis, has been appointed dean of the school to succeed Dr. Nathaniel Allison, who becomes professor of orthopedic surgery at Harvard University Medical School, Boston.

PROFESSOR C. W. PARMELEE has been made head of the department of Ceramic Engineering at the University of Illinois, where he has been professor since 1916.

PROFESSOR J. W. MCCOLLOCH, of the Kansas State College, has been named acting head of the entomology department at the college during the absence of Professor G. A. Dean, who has a year's leave of absence.

DR. ALFRED S. ROMER has been appointed associate professor of vertebrate paleontology in the University of Chicago. Dr. Romer has been working in the American Museum of Natural History and the department of anatomy of New York University.

EDWIN B. POWERS, associate professor of anatomy at the College of Medicine of the University of Tennessee, at Memphis, is on leave for the year to take charge of the department of zoology of the University of Tennessee at Knoxville.

DR. CHARLES F. MARTIN has been appointed dean of McGill University faculty of medicine to succeed Dr. George E. Armstrong.

DR. GEORGE D. PORTER has been appointed head physical director at the University of Toronto to succeed Dr. James W. Barton, who resigned last spring.

DISCUSSION AND CORRESPONDENCE

THE SIGNIFICANCE OF THE "FOLIAR RAY"

IN a recently published article entitled "The significance of the 'Foliar Ray' in the evolution of Herbaceous Angiosperms" it becomes evident that the authors now have their facts in hand. May we ask that they will credit us with the same elementary common sense. The difference of opinion seems to have resolved itself mostly into a question of terminology. In the original article by Messrs. Sinnott and Bailey which appeared in 1914 there was a fundamental misconception. The bands of "interfascicular parenchyma" found in herbaceous stems are decidedly not the homologues of the radial bands which subtend the leaf traces. The attribution of such an idea to "Jeffrey and his school" was a mistake and the demolition of this man of straw has wasted much valuable journal space.

The writer believes that our critics still fail to realize the importance of nodal modifications around incoming leaf traces where storage is initiated. That the thinning of the stem and consequent obliteration of the radial storage ray led to the vertical extension of the flanking portions is still our own belief. Incoming food must be stored somewhere, and if the old storage region is being obliterated through a reduction in the foliar parenchyma outside the trace what is more logical than to suppose that the flanking tissue played up to fit the new situation.

Conversion of tracheidal tissue into parenchyma on

the flanks of a leaf trace may be called "widening of medullary rays" if one finds greater satisfaction in such a designation. In teaching the herbaceous stem, however, the writer has found that the student grasps the situation better when he realizes that the subtending nodal ray and the parenchyma which flanks the trace on either side are but parts of one physiological system specialized for food storage. As to its actual phylogeny this tissue would seem to represent a complex of vertical parenchyma united with vertical series of rays, but since the same thing can be said of the subtending ray there is no real difference between them. The flanking tissue is certainly not a single ray broadened out. Our critics are in danger here of setting up the same subtle doctrine of specificity of tissues that animates those realists who are so obsessed by the Platonic Idea of the stele that they can sense imaginary lines running across a leaf gap to separate cortex from pith.

As to the fact that some trees and shrubs have foliar rays, that would seem to have been known for some time. In fact it serves as the very basis from which the theory takes its departure. The damning fact that certain herbaceous stems, on the other hand, have "essentially continuous vascular cylinders" is to be regretted, perhaps, but it only shows that nature refuses to be forced into ways of absolutism in her operations.

So far as the writer can see we have come to a substantial basis of agreement as to facts.

Messrs. Sinnott and Bailey admit that foliar rays may occur in aerial stems, and they realize that "high multiseriate rays" or flanking storage parenchyma of a leaf trace is not the same thing as a subtending ray, hence they won't search any longer for leaf traces on the central side of such a flanking band.

The writer, on his part, is willing to call flanking tissue a medullary ray, though truth to tell, both terms are poor ones for the tissue in question. Further he gladly admits the existence of trees with leaf rays and herbs without any.

So all considered we come to substantial agreement as to how a tree became an herb. As far as the writer is concerned the affair is closed.

R. E. TORREY
MASSACHUSETTS AGRICULTURAL COLLEGE

FEMORAL DEFORMATION

DURING an examination of skeletal material from an archeological site at Roebuck, Ontario, it was found that in many cases a certain amount of dissimilarity existed between the right and left femora of the same individual. When paired femora were placed side by side on the same level, and with their condylar extremities together, it was found that their heads were on different levels, the right being usually the higher. This difference in the heights of the heads was due to a difference in the forward angles of the necks of the femora, that is, the angle between the neck of the femur and the horizontal. No twists or other abnormalities were observed in the shafts.

The deformity seems to have been very general among the inhabitants of this site. Of twenty-three pairs of adult femora examined, only three pairs were normal. The deformity is noticeable also among the bones of children, and even among infants so small that it is quite certain that they never walked. This would seem to prove that the deformity was congenital, and shows that it was certainly not the direct result of any habitual occupation.

Detailed examination has been made only in the case of adult skeletons. It shows that of twenty-one pairs of bones seventeen had the right deformed and six the left, two pairs having both bones deformed. In the case of the latter, the inclination of the necks was in opposite directions.

Although it has been asserted that the apparent hereditary nature of the deformity shows that it was not the direct result of habitual occupation of any sort, still habitual occupation may have been its primary cause. If it had been caused for generations by occupation it would ultimately, it may be presumed, be handed on by heredity; and thus a theoretical cause for the deformity may be found both in the case of adults and of children.

G. E. RHOADES
OTTAWA, CANADA

A CASE OF SUPERSENSITIVENESS TO THE POISONOUS ACTION OF THE CASTOR BEAN

THE frequency with which the castor bean seed is used in elementary courses in botany makes it seem advisable to record a case of supersensitiveness to the poisonous action of the castor bean plant which came under my observation.

The subject, Miss K., while taking the laboratory work in botany as a student developed a severe case of what appeared to be hay fever. It was apparently associated with something used in the laboratory. Not until a year later when she acted as an assistant in the same course was the castor bean found to be the cause.

The attacks were initiated with severe sneezing and some headache and general discomfort a few minutes after exposure. Her face became inflamed and puffy, eyes reddened and swelled, breathing was accompanied by a wheezy sensation. The mucous membranes were decidedly irritated and later cracked. The surface of the cornea of the eye in some cases became slightly wrinkled. After the heaviest attack

Miss K. was confined to her bed for three days, and the after-effects lasted for two weeks.

It was not necessary for her to handle the castor beans but merely to be in the room where they were dissected. In fact, in one instance a few beans were used in the laboratory in the morning from 10 to 12 when Miss K. was not present and was not aware of their being used. A few minutes after she came into the laboratory in the afternoon at one typical symptoms with sneezing and headache developed.

The castor bean plant had an effect similar to that of the bean. Within a few minutes after cutting the leaves and stems of a castor bean plant for histological purposes Miss K. suffered from a mild but typical attack.

Out of several hundred students the case mentioned is the only one of its type I have observed. It was noted, however, that one of the instructors suffered from a badly inflamed eye due to rubbing it with his fingers after dissecting some castor beans. Pammel, in discussing the castor oil bean in his manual of poisonous plants, states that "a case is known of a young lady whose eyes became inflamed when in contact with a mere trace of the material in the laboratory."

Effects from the castor bean similar to those described may be mistaken for colds or for attacks of hay fever produced by pollen.

William J. Robbins
University of Missouri

QUOTATIONS

INDUSTRY AND CHEMICAL RESEARCH

Why do clear-thinking, well-informed business men who hold the stock or compose the directorates of companies in our chemical engineering industries so frequently disparage a policy of research? An old riddle which is growing more perplexing as it ages! To regard a technical staff as a semi-liability at best, to dispense with it whenever storm clouds gather on the business horizon—such is altogether too frequently the creed of those who pass upon expenditures. No more clear-cut evidence of such folly, or rather the wisdom of the maintenance of research, has come to our attention recently than the remarkable story of achievement made by one of the great yeast companies. This story is at once an inspiration to the research worker and a rebuke to those whose first thought is to reduce the technical staff in time of financial difficulty.

A few years ago yeast was made by this particular company from a cereal mash on an enormous scale and in eleven plants. About one quarter of the grain was converted to yeast; from the mash alcoholic beverages and allied products were produced which yielded sufficient revenue to make possible a very low margin of profit on the yeast. Then came our entrance into the war. Edible cereals could no longer be used. Research found a manner of using oats as a substitute. Labor cost rose as high at 250 per cent. above the pre-war level. As an offset to this, research developed a process to increase the yield to a figure previously unheard of.

Then prohibition came, seemingly to cap the climax. Competition with industrial alcohol makers could not be met with the costly high-grade grain alcohol produced by this process. Yet without this market the cost of yeast must be substantially increased. Again after a real struggle on the part of the research staff in a comparatively unknown and poorly charted field of chemistry the answer was found—production from new materials with the evolution of no alcohol and of almost no other side products. The net result of its research, which was well paid for, enabled this company to maintain its retail prices at pre-war standards through years of rapidly shifting economic conditions. Its process reached an efficiency of practically 100 per cent. conversion of raw material to yeast. Its product was improved, its sales were increased, its research facilities developed to the highest point. And all this through a period when many firms were endeavoring to weather the storm by putting a sign over the laboratory door, "This Way Out."

We have cited other similar instances; we shall cite more. Research, despite the many kicks it has had, is alive and growing. Here is added justification for our contention that it is indispensable in trying as well as in prosperous periods. Properly directed, there is no better manner of insuring increased dividends.—*Chemical and Metallurgical Engineering.*

SCIENTIFIC BOOKS

Text-book of Agricultural Bacteriology. By F. Löhnis, Ph.D., U. S. Department of Agriculture, and E. B. Fred, Ph.D., University of Wisconsin. New York, McGraw-Hill Book Company, 1923, 283 pp., 10 plates, 66 illustrations in the text.

This work, as the authors indicate in their preface, is largely based upon the senior author's "Vorlesungen über landwirtschaftliche Bakteriologie," published in 1913, and representing the material collected during eleven years' experience in teaching and research at the University of Leipzig. It is, moreover, more than a translation of Löhnis's "Vorlesungen," representing a thorough revision and a rearrangement of the subject matter to make it more useful to the American and British reader.

Following an introduction which includes a survey of the history and scope of bacteriology, the authors pass to the main portion of the book which is divided

into two nearly equal parts: Part I—"General morphology and physiology of bacteria and related organisms" and Part II—"Dairy and soil bacteriology." Realizing more than most authors the importance of making the student of bacteriology acquainted with the fundamental principles of morphology and physiology before proceeding to the applied bacteriology of agriculture, the authors have wisely devoted half of their book to this important subject.

This ground has been thoroughly covered in a distinctive and unusually instructive fashion. The refreshing originality of the "Vorlesungen," in the opinion of the reviewer, lies in the fact that this work closely followed the form of the author's own lectures in agricultural bacteriology. In this new work the subject-matter is handled in essentially the same order, and although the actual subdivision into lectures has been somewhat changed, the original logical method and lucid style are preserved. The seven chapters of the first part deal with the fundamentals in such a way that the student is well prepared for the specialized parts that follow, and students of other branches of bacteriology than agricultural will find this half of the text-book well worthy of study. Not only are bacteria discussed, but related microorganisms, yeasts, fungi and protozoa are included in relation to their development and activities. Subjects dealt with include morphology, development, classification, relation to environment, methods of cultivation, control and physiological activities and relationships. The chapter on the activities of bacteria and related microorganisms, comprising some sixty pages, is specially thorough, and covers such subjects as the cycles of the elements in an unusually clear manner.

Part II deals with dairy and soil bacteriology. Following a chapter on the microbiology of foodstuffs are chapters on the relation of bacteria and other microorganisms to milk, butter, cheese, water and sewage, manure and soils. It might be objected that the important subjects of bacteria in relation to animal and plant diseases have not been covered. Both these fields, however, represent more or less distinct lines of scientific specialization, in distinction to that which is usually understood as agricultural bacteriology, and are related more properly to veterinary medicine and general plant pathology. The authors have mentioned their bearing to bacteriological physiology in Part I, but have, as indicated, reserved Part II for dairy and soil problems. To these seven chapters have been dedicated, and the authors, in considering the various subjects, have followed the uniform plan of discussing first germ content, then bacterial activities and following up with the practical application in each case.

Throughout the book adequate references on all essential points are made to the special literature of the subject, and in this regard the authors have included the most recent investigations. Special mention must be made of the illustrations in this textbook, almost all of which are original. These consist of 66 figures and 10 full-page plates, of which 7 are colored. For originality and excellence of reproduction these are the best we have seen in bacteriological literature, and add greatly to the value of the work, which is to be highly recommended for student use.

A. GRANT LOCHHEAD

OTTAWA, CANADA

SPECIAL ARTICLES

A REMARKABLE DEVELOPMENT OF THE SPOROPHYTE IN ANTHOCEROS

THE genus Anthoceros is of special interest, as it more nearly approaches the Pteridophytes in the character of its sporophyte than does any other Bryophyte.

Of the American species of Anthoceros, *A. fusiformis* Aust., a very common species of the Pacific Coast, has much the longest sporophyte, which frequently reaches a length of two to three inches, or even more. The sporophytes are often produced in large numbers, so that a patch of fruiting plants looks like a tuft of fine grass.

The writer recently received from Dr. G. J. Peirce a number of specimens of *A. fusiformis* collected near Carmel, California, which showed a development of the sporophyte far exceeding anything hitherto recorded, so far as he is aware.

Some of these were full six inches (16 cm) in length, and were still actively growing. This is nearly twice the maximum length, 9 cm, recorded by Howe[1] for this species, and much exceeds anything seen by the writer in many years' collecting of Anthocerotaceae in various parts of the world.

Not only was there a remarkable increase in length, but the sporophytes were notably thicker than the normal ones.

Sections of some of these enlarged sporophytes showed that spore-formation had been almost completely suppressed in the basal region and the outer green tissue was much more extensive than in normal sporophytes. Still more striking was the greatly increased size of the central strand of tissue (columella), which might almost be denominated a simple vascular bundle.

The foot was also greatly enlarged and in two cases examined, the lower surface was almost completely exposed, and it is quite possible could absorb

[1] Howe, M. A., "The Anthocerotaceae of North America," *Bull.* Tor. Bot. Club, 24, p. 17, 1898.

water from below, without the intervention of the gametophytic tissues which had mostly withered. Indeed it looks as if these large sporophytes may have attained very nearly the complete independence characteristic of the Pteridophytes.

Usually *A. fusiformis* ripens its spores in the late spring, and both gametophyte and sporophyte dry up completely. The former, however, revives with the autumn rains. These large sporophytes were undoubtedly left over from last season and probably began to form some time in the autumn of 1922, as fertilization normally takes place within a short time after the first heavy rains, which last year fell early in October.

The writer visited the locality, San Jose Canyon, where these were collected. This is one of many small canyons south of Monterey, open to the ocean, so that they are invaded by the summer sea-fogs. There is a permanent stream, along whose banks fine redwoods, sycamores and alders were growing, as well as a rich growth of such liverworts as Fegatella and Marchantia, and several mosses.

The Anthoceros plants grew on low sandy banks, not far above the water level, and some of them showed fresh growth and bore a number of relatively young sporophytes.

Douglas Houghton Campbell
Stanford University

THE EFFECT OF THE REMOVAL OF THE MICRONUCLEUS

The micronucleus in ciliates has commonly been considered to have solely a germinal function. In contrast with the macronucleus which, it is thought, serves for the upkeep of the individual, the micronucleus on the other hand is believed to provide exclusively for the maintenance of the race. This theory chiefly originates in applying to the *Ciliata* Weismann's hypothesis on the continuity of the germ plasm.

To ascertain the actual function of the micronucleus one must, of course, finally provide experimental means. This has been done by certain investigators (Balbiani, LeDantec, Lewin, *et al.*) who have removed the micronucleus from several ciliates, but this was accomplished by the excision of that part of the organism wherein the organelle lies. This method entails the burden of the regeneration of more or less of the organism and involves the possible removal of equally important stuffs.

The removal of the micronucleus from the fresh-water ciliate, *Euplotes patella*, has been successfully accomplished in more than fifty specimens by means of a mercury micropipette without causing any additional injury except the loss of a meager amount of cytoplasm immediately surrounding the removed organelle. *Euplotes* so operated upon have never lived longer than five days nor have they divided more than twice, so far as could be observed. A number failed to divide at all and lived only two days. The average life is about three days. Specimens which were fixed and stained showed an absence of the micronucleus, hence it was not regenerated. Individual controls from which cytoplasm of various regions of the organism or portions of the macronucleus had been removed formed vigorous races.

The few earlier reports, especially of Lewin and LeDantec, of ciliates having formed thriving races or having regenerated the micronucleus, after the experimental removal of this organelle, have not been substantiated by any of the experimental work done within the past dozen years. Several races of different species of ciliates have recently been intensively studied (Woodruff) and found to exhibit no morphological micronucleus. These races thrive apparently indefinitely. Conjugation either is not attempted or the conjugants always die. Two of these races have been known to arise from a micronucleate race which did conjugate normally. Woodruff (1921) has suggested that the macro- and micro-nucleus may have formed together in such races an "amphinucleus," which would be adequate for all life phenomena, but which would not permit the germinal chromatin in the micronucleus to become available for conjugation and endomixis. A morphological micronucleus would, accordingly, not be necessary for the vegetative life of the organism. The occurrence of such a nuclear change, however, is as yet not established.

If the micronucleus is solely germinal in function, it would be expected that a ciliate with no other injury than the loss of this organelle would give rise to a race asexually. The evidence from experiments on *Euplotes patella* goes to show that it can not continue to live and divide without the micronucleus. Just what rôle further than germinal the micronucleus plays is problematical. Hertwig, Calkins and others have maintained that the nucleus gives off certain formative substances, perhaps like enzymes, which are exhausted during cell-division. The results of the experiments thus far carried out on *Euplotes* suggest that the micronucleus performs some such rôle in the economy of this ciliate. The amount of the hypothetical substance present in the cytoplasm at the time of the removal of the micronucleus would determine the number of divisions possible before death. Division being impossible, death might ensue from a condition comparable to senescence in the metazoan cell or possibly from a surfeit of food which would normally be relieved by division.

C. V. Taylor
University of California

THE AMERICAN CHEMICAL SOCIETY

DIVISION OF PHYSICAL AND INORGANIC CHEMISTRY

Robert E. Wilson, *chairman*
Graham Edgar, *secretary*

The use of radon in studying radio-chemical problems: S. C. LIND.

The determination by a chemical method of the mean effective path of alpha-particles in small spheres: S. C. LIND and D. C. BARDWELL. The mean linear path of alpha-particles in a gas contained in a sphere depends on the point of origin of the particle. If from the wall, it is 0.5 × the radius of the sphere; if from the gas itself, it is 0.75 × the radius. In order to determine the exact value under the experimental conditions in gas reactions, two series of measurements were made of the rate of combination of electrolytic hydrogen and oxygen: (1) with radon confined at the center of the reaction sphere, (2) with it mixed with the gases. The ratio of the velocity in (2) to that in (1) is, after suitable correction, that fraction of r sought. The value obtained is 0.61 × r. A possible interpretation in terms of diffusion of active deposit is presented.

Revision of the chemical effect of recoil atoms: S. C. LIND and D. C. BARDWELL. The experiments on the effect of recoil atoms in contributing to the chemical effects of radon in hydrogen and oxygen electrolytic mixture have been repeated under somewhat more favorable conditions than those originally employed in part II. The results confirm the earlier experimental ones satisfactorily. Certain apparent discrepancies between the inverse square of the diameter law and the recoil atom effect are removed.

Oxidation, reduction and decomposition of the oxides of carbon: S. C. LIND and D. C. BARDWELL. The rate of the following gas reactions have been studied kinetically when produced at ordinary temperature by radon: The decomposition of CO and of CO_2 (no reaction); oxidation of CO by O_2; reduction of CO and of CO_2 by H_2. All of the rates are relatively rapid except that of decomposition of CO_2. The M/N values are mainly those to be expected on the theory of active gas ions forming addition products with one or two neutral molecules. The theory is advanced that the CO_2 ion reacts with neutral CO_2 to form an addition product (just as in the case of CO), but that this complex again decomposes into CO_2, giving no resultant reaction. This is supported by the evidence obtained by introducing H_2 as an acceptor for the CO_2 ions which is found to lead to rapid reduction of CO_2. It is shown that it is not merely a matter of the action of active hydrogen on neutral CO_2. The products of all the reactions have been analyzed, but owing to the small quantities of gases being dealt with, some of the results are not yet regarded as final.

A method for photographing the disintegration of atoms, and photographs of single and double atomic collisions, and a new type of rays: WILLIAM D. HARKINS and R. W. RYAN. In the collision of an alpha particle or helium nucleus with the nucleus of an atom of air three tracks are seen to radiate from a point. If a fourth track is present it represents either (1) the disintegration of the bombarded nucleus, or (2) a double collision. In a simple collision momentum is conserved, and all of the tracks lie in one plane. In a disintegration or a double collision momentum should be conserved if all of the tracks are considered, but, unless by accident, all of the tracks will not be coplanar. By taking 41,000 photographs of alpha ray tracks in air, argon and other gases the writers have obtained two photographs which represent either double collisions, a very improbable event, or an atomic disintegration. One of these was obtained in air, the other in argon. The photograph in argon gives the appearance to be expected if the helium nucleus first hit an argon nucleus and the argon nucleus, within a distance of ½ mm, hit a second argon nucleus. A double collision of this kind is very much more improbable in air than in argon, and the photograph secured in air seems to indicate that a double collision did not occur. A new kind of rays, called zeta rays, have been found.

Reactions in phosgene solution. I: ALBERT F. O. GERMANN. Liquid $COCl_2$ does not react with metals nor is it in general a solvent for metallic salts (Beckmann and Junker). It dissolves $AlCl_3$ readily, forming phosgenates (Baud). Potassium, distilled in vacuo, covered with liquid $COCl_2$, shows no tarnish after a year; this is typical of the inactivity of the metals towards this solvent. However, covered with $COCl_2$ and exposed to the sunlight in ordinary soft glass tubes, potassium becomes coated with a violet deposit, which has the appearance of finely divided potassium; copper and zinc are corroded; and aluminium dissolves as $AlCl_3$, producing a yellow solution, which soon develops enough color to stop the reaction by absorbing the active wave lengths; in each case a gas (carbon monoxide) is evolved during isolation; magnesium is not attacked. Amalgamation makes Al active towards liquid phosgene, but has no effect in the case of Zn and Cu, whose chlorides are insoluble. Chlorine dissolved in $COCl_2$ attacks Al and Hg, but does not attack Mg. $COCl_2$ containing dissolved $AlCl_3$ attacks potassium, producing a rather voluminous precipitate and evolving a gas. The behavior of $COCl_2$ towards the metals in the presence of $AlCl_3$ is so unusual that this type of reactions has been given special study, the results of which are presented in another paper. Liquid $COCl_2$ converts KI into KCl and I_2, crystals of iodine separating from the solution as the reaction proceeds; CNI is more slowly decomposed; the usefulness of $KI + Na_2S_2O_3$ to separate Cl_2 from $COCl_2$ is thus brought into question.

Reactions in phosgene solution. II. The reaction of calcium with phosgene: ALBERT F. O. GERMANN and KENNETH A. GAGOS. It has been shown that, while metals in general do not react with $COCl_2$, a reaction may take place in the presence of $AlCl_3$, which is very soluble. In a preliminary survey, magnesium, calcium, zinc and cadmium, as well as potassium (as indicated in a previous paper) were found to yield a gas, shown to be carbon monoxide, with $COCl_2$ in the presence of $AlCl_3$. The compound with magnesium is liquid at ordinary temperatures, becomes very viscous when cooled, and yields a two layer system with $COCl_2$. This compound is under investigation. The compound with cadmium is

solid, and appears to be very soluble, but the reaction is slow; other methods of preparing it are being worked out. Calcium and magnesium react with great readiness, so that the reaction comes to completion in a relatively short time. It was found that the amount of action was proportional to the amount of $AlCl_3$ present, provided metal and $COCl_2$ are in excess. By saturating solutions containing weighed amounts of $AlCl_3$, and dephosgenating the salt formed, residues of constant composition were formed, whose analysis led to the formula $CaCl_2.2AlCl_3$. Vapor tension-composition measurements at 19.5° C. showed that the crystals separating from the solution contain two molecules of phosgene, so that their formula is $CaCl_2.2AlCl_3.2COCl_2$. The vapor tension of the compound at this temperature is about 25 mm.

The critical temperature and pressure of phosgene: Albert F. O. Germann and Quimby W. Taylor. Measurements have been made of the critical temperature of $COCl_2$, but as far as we are aware, the critical pressure has not been measured. The $COCl_2$ used in this investigation was a technical sample obtained from the Chemical Warfare Service, and was purified by passing the gas over the usual absorbents for impurities, and by repeated fractional distillation under diminished pressure, until the vapor pressure at zero became constant. It was found impossible to prepare pure $COCl_2$ in this way (see also Science, 57, 564), as not one sample examined showed monovariance when liquefied at higher temperatures. The value obtained for the critical pressure, $Pc = 65$ atm., is therefore probably somewhat too high. The value obtained for the critical temperature, $Tc = 273 + 182$, is one degree below that obtained by Hackspill and Mathieu, and five degrees below that obtained by Paterno and Mazzuchelli.

The measurement of the heat of adsorption of gases by catalysts: R. A. Beebe and H. S. Taylor. A method has been devised for the direct measurement of heats of adsorption. It consists in determining the temperature rise produced in the mass of a given catalyst when the gas to be studied is introduced into the system. The catalyst material is contained in a special vacuum vessel to facilitate thermal insulation. The heat capacity of the system is determined by liberating into the system a measured amount of electrical energy, using a resistance wire distributed throughout, but insulated from, the catalyst. The heats of adsorption of hydrogen on nickel and on copper have been determined as 14,000–20,000 calories and 9,600 calories respectively per mol of adsorbed gas. These values are markedly higher than the heat of vaporization (450 calories approx.). The measurements are being extended to other gases, other catalysts, and other preparations of the above catalysts, since the values obtained depend in part on the characteristics of the adsorbant.

Studies on solubility. The ideal activity coefficient of strong electrolytes in the presence of mixed electrolytes: J. N. Brönsted and V. K. LaMer.

Overvoltage: William D. Harkins and H. S. Adams. The hydrogen overvoltage of mercury is found to be a linear function of the logarithm of the current density over a very extensive range if the cathode is carefully prepolarized; it decreases 2 millivolts per degree of rise of temperature, and remains constant as the pressure is varied between 14 and 2,300 mm. Stirring the electrolyte by a stirrer or by bubbling gas through it decreases the overvoltage of a number of metals, especially for those of high overvoltages at low current densities. A superimposed alternating current lowers the overvoltage in most cases but increases that of copper except at very low current densities, whether the copper is smooth or rough. The overvoltage of 12 metals at 25 degrees was determined over a considerable range of current density. In agreement with the early observations of [illegible] overvoltage is found to be related to the position of the element in the periodic system. Rough cathodes were found to give lower overvoltages than smooth ones. Overvoltage increases with time.

Two types of overvoltage: L. J. Bircher, William D. Harkins and Gerhard Dietrichson. Opposite opinions concerning the characteristics of overvoltage have arisen through the failure to recognize that there are overvoltages of two types. What we will designate as type A overvoltage is peculiar to active metals, has a positive temperature coefficient and its value corresponds closely to the single potential exhibited by the metal. This type of overvoltage persists in certain instances even though the current density is quite high. Certain recent investigations have given incorrect indications as to the characteristics of ordinary overvoltage by carrying out the work in a range in which overvoltage of type A is partly in effect. Ordinary or type B overvoltage has a negative temperature coefficient which for the current densities investigated, is 2 mv per degree for mercury, gold and copper; so thus far it has been found to be independent of the metal.

Effect of pressure upon overvoltage: In 1914 Harkins and Adams found that the hydrogen overvoltage of mercury remains practically constant between 14 and 2,300 mm, and Newbury found oxygen overvoltage to be constant between 1 and 100 atmospheres. Later work by other investigators indicates that on the contrary hydrogen overvoltage, at least for mercury, lead and nickel, increases with extreme rapidity as the pressure is lowered below 300 mm. The present investigation shows that the apparent great increase is fictitious, and is probably due to the failure of the comparison hydrogen electrode, used also as an anode, to function properly at low pressures. The present work indicates that in the cases of mercury, lead, and nickel at least, the potential of the cathode remains constant as the pressure is lowered to 11 mm, so the increase of overvoltage is very slight, being equal only to the small decrease of the potential of the hydrogen electrode. These results were obtained by using the mercurous sulphate electrode, instead of the hydrogen electrode, as the direct standard of reference, and by a comparison of the hydrogen and mercurous sulphate electrodes at different pressures.

Adsorption by precipitates VI; the adsorption of precipitating ions from mixtures of electrolytes: Harry B. Weiser. The precipitation value for colloids of mixtures of electrolytes is influenced by the so-called antagonistic action of the precipitating ions and by the stabilizing

action of the ions having the same charge as the colloid. In cases where the influence of the stabilizing ion is slight, the precipitation values of mixtures show an approximately additive relationship since the antagonistic action of ions even of varying valence is not so marked as usually supposed in the region below the precipitation concentration of each. On the contrary, the antagonistic action is frequently so slight that the precipitating effect of mixtures of ions of the same or varying valence is less instead of greater than the additive value because of relatively greater adsorption of each at concentrations considerably below their precipitation value. Investigations on the hydrous oxides of iron, chromium and tin with precipitating ions showing a wide variation in their degree of hydration, disprove Freundlich's view that the hydration of a colloid and of the precipitating ions determines whether coagulation takes place at a higher concentration with mixtures than with a single electrolyte. The precipitation value of mixtures is higher than that of a single electrolyte in case an ion having the same charge as the colloid is so strongly adsorbed within certain concentrations that it opposes the action of the precipitating ions.

Adsorption of dyes by gels under a varying pH: R. E. MARKER and NEIL E. GORDON. Solutions of acid and basic dyes of a varying hydrogen ion concentration were shaken with silica, alumina and ferric oxide gels until equilibrium was established. The adsorption of dyes was then determined when it was found that the amount adsorbed by the ferric oxide and alumina gel in most cases was a function of the hydrogen ion concentration, while the change of adsorption with hydrogen ion was small in most cases with the silica gel.

Adsorption of dyes by gels under a varying pH in the presence of inorganic salts: C. E. WHITE and NEIL E. GORDON. The adsorption of acid and basic dyes was tried with silica, alumina and ferric oxide gels, while the hydrogen ion was changed within such limits as were possible under the conditions of the experiment, and while some inorganic salts of a definite concentration (usual .05N) was present. The inorganic salts cut down the adsorption in most cases.

Adsorption by activated sugar charcoal: ELROY J. MILLER. Evidence is presented to prove that adsorption of electrolytes from solution is accompanied by hydrolysis. Solutions of a number of salts when treated with pure, ash and nitrogen-free, activated sugar charcoal became alkaline, indicating that some hydrolysis had taken place with subsequent adsorption of the acid. By suitable means these adsorbed acids were recovered from the charcoal, identified and found to be equivalent in amount to the bases set free. This is in accord with the results obtained by Bartell and Miller (*J. Amer. Chem. Soc.*, 44, 1966 [1922], 45, 1106 [1923]) and in disagreement with the views of Michaelis and Rona (*Biochem. Zeit.*, 97, 57 [1919]), and Odén and Anderson (*J. Phys. Chem.*, 25, 311 [1921]), who maintain that hydrolytic adsorption does not take place.

Adsorption of inorganic salts by alumina gel under a varying hydrogen ion concentration: E. B. STARKEY and NEIL E. GORDON. .05N solutions of potassium nitrate, potassium sulfate, potassium acid phosphate and the same salts of calcium, each having a varying hydrogen-ion concentration, were shaken with alumina gel until equilibrium was established. The adsorption of the different ions was determined. It was found that the hydrogen-ion concentration had marked effect on the amount of adsorption of the respective radicals.

The rôle of hydrogen ion concentration in the precipitation of colloids: H. V. TARTAR. A study has been made of the effect of hydrogen-ion concentration (pH) on the precipitation of mastic, gamboge, arsenious sulfide and aluminium hydroxide with electrolytes. Each of the negatively charged colloids is precipitated by acids at a given hydrogen-ion concentration regardless of the concentration of the sol. Different bases precipitate aluminium hydroxide sols of varying concentrations at the same pH. With salts, equal concentrations of ions of the valence are required to precipitate a given sol at the same pH and in nearly all cases the ion bearing a charge similar to that of the colloid particle is without effect. The efficiency of ions in precipitation is not absolute but must be considered with reference to the hydrogen-ion concentration.

Effect of light and H-ion concentration on the formation of colloidal gold in silicic acid gel. Rhythmic bands of purple of Cassius: EARL C. H. DAVIES. Experiments show that with silicic acid, gold chloride gels some remarkable effects of light are evident and that it is the light of short wave lengths which functions, if H_2SO_4 is present. The experiments remove W. D. Bancroft's objection to H. H. Holmes' diffusion theory of Liesegang band formation. A series of experiments shows that there is a distinct relation between H-ion concentration and the size of the "pockets" in which the gold is formed. A striking lecture experiment shows the influence of light on reduction. Purple of Cassius was obtained in true Liesegang bands.

The effect of hydrophillic colloids on the size and distribution of particles in electrolytic precipitation. I. Gelatin and basic lead carbonate: DORMAN MCBURNEY and W. G. FRANCE. The analogy between the effect of gelatin on the character of the deposit in the electrodeposition of metals and the electro-precipitation of salts is suggested. The effect of gelatin on the size and distribution of particles in the electro-precipitation of basic lead carbonate at $20° + 1°$ was studied. Photomicrographs of the product were taken and the size and distribution of particles determined by the method of Green. The data indicate that the presence of gelatin in concentrations from 0.013 per cent. to 1 per cent. is accompanied by a marked decrease in the average size of the particles of basic lead carbonate. A product of much greater uniformity in particle size is obtained in the presence of gelatin than in its absence.

Sol stability under centrifugation: W. G. FRANCE. The relative stability of a number of sols under centrifugation has been determined by observing the time required for the precipitation when definite volumes of sols are acted upon by known centrifugal forces. The sols investigated were $Fe(OH)_3$; Sb_2S_3; gold prepared by three different methods; and an ethyl alcohol gold sol

prepared by the Bredig method. The decreasing order of relative stability was found to be $Fe(OH)_3$; Sb_2S_3; gold by Bredig method; gold by Tannin reduction; gold by formaldehyde reduction; and gold ethyl alcohol sol by Bredig method. It was further observed that, on standing after precipitation, the precipitated phase gradually diffused back into the dispersion medium in all cases except that of the ethyl alcohol, provided that centrifugation had not been carried on too long after precipitation. It is suggested that the stability may in part be accounted for on the assumption that a protective action is exerted by adsorbed films of the dispersion media, the nature of which are influenced by the methods of preparation of the sols.

A theory of emulsions and the inversion of emulsions: William D. Harkins. In 1917 the writer proposed a theory according to which the stability of emulsions, of the type produced by soaps, is dependent upon the existence, around the droplets, of a film of molecules, with the polar ends oriented toward the water, and the nonpolar end toward the oil. A second, and independent, part of the theory considered the molecules as capable of representation as the frustra of cones (or in a plane as wedges). With sodium oleate drops of oil form inside the water. By a change from sodium to magnesium or calcium oleate the cross section of the polar or water-like end of the molecule is not greatly changed, but the substitution of two paraffin hydrocarbon chains for one increases the cross-section of the non-polar or oil-like end by about 42 per cent. Thus the polar end of the molecule becomes the smaller end of the frustrum; so the emulsion is inverted and the water drops become the inside phase. Naturally the size of the polar end of the molecule is also of importance. The paper will present evidence in favor of the theory.

A method for the study of rapid adsorption of gases in liquids: P. G. Ledig and H. E. Weaver. An apparatus is described which gives a photographic record of the course of absorption of a CO_2 bubble in a stream of hydroxide solution. From this photographic record the rate of absorption over the period of the absorption can be determined. A number of figures are presented showing the effect of concentration, bubble volume and other variables upon the rate of absorption.

The free energy of mercurides: Roscoe H. Gerke. Alloys and metallic compounds are important classes of substances for which there are few free energy data. It is the purpose of this paper to collect available data on metallic compounds and solid solutions containing mercury, and, incidentally, point out that the method of calculating these quantities involves the use of partial molal free energy. Hitherto, the concept of partial molal free energy has not been used to split up the free energy of formation of a compound from its constituent elements into two parts, as has been done in this paper. In the case of the mercurides, and other metallic compounds, it will be seen that the free energy of formation of the compound from its elements is equal to the sum of the separate free energy changes which the elements undergo in the formation of the compound.

The conventions have been such that the free energy of formation, ΔF (25 degrees) $= -18{,}351$ calories, means that there has been a decrease at 25 degrees and 1 atm. of free energy attending the formation of one mol of $NaHg_5$ from one atom of Na and 5 atoms of Hg. This decrease has been divided between the decrease for the sodium and the mercury respectively, such that $\bar{F}_2$ equals $-18{,}046$ calories and $\bar{F}_1$ equals 61 calories per atom. It is to be noted that the more electropositive the metal, the greater is the free energy change, except for the case of lithium.

The most striking and unexpected conclusion which can be drawn from these data is that the mercury does not greatly change in free energy, when it enters into chemical combination with a more electropositive metal. In other words, the vapor pressure of pure liquid mercury is only very slightly greater than the partial pressure of mercury from an amalgam saturated with a mercuride. On the other hand, the electropositive metal decreases in free energy more than the mercury in the formation of the compounds.

Although the free energy of other metallic compounds and also compounds of the type represented by iodine chloride can be calculated by the above method, it does not seem feasible to make similar measurements for a simple compound such as sodium chloride, since it is not possible to have solid sodium chloride in equilibrium with its solution of sodium in liquid chlorine.

In conclusion, it may be stated that, if mercury reacts with a more electropositive metal to form a mercuride, the change in free energy for the mercury is small compared with that of the more electropositive metal.

A relation between energy of reaction between atoms and electron affinity of electronegative atoms: Roscoe H. Gerke. The energy of formation of halides from monoatomic elements in the gaseous state has been found to give an approximately constant value. In the case of KCl, NaCl, HCl, TlCl and AgCl, the values are respectively, 124.4, 115.3, 109.5, 108.3, 98.0 Kg. cal. The average energy of formation is 111.1 Kg. cal., which is in close agreement with the value, 111.0 Kg. cal., for the electron affinity of chlorine. In the case of bromides and iodides the agreement is not so close. These rough agreements seem to indicate that the energetics for these simple chemical reactions are accounted for by the differences in energy level of electrons in the atoms before and after the reaction. Also, the order of electropositive elements in the electromotive series seems to be governed by the heats of evaporation of the electropositive elements and the heats of sublimation of their compounds.

Relations involving the disintegration of atoms: William D. Harkins. The paper shows that the work of Rutherford on the disintegration of light atoms directly confirms the first definite theory of the composition of the light atoms, that of Harkins and Wilson. Thus, atoms in which the hydrogen is bound in the form of alpha particles have in no case given off hydrogen when bombarded by swift alpha particles. Also atoms in which the theory indicates that the part or parts of the nucleus which contains hydrogen not bound into alpha particles has the formula pe or $(pe)_2$, have not disintegrated to give long range hydrogen particles. Thus, as

indicated by one of the corollaries of the theory proposed by Harkins, hydrogen is found to be in unstable combination only when the part of the nucleus which does not consist of alpha particles contains more protons than electrons. This correspondence between the experimental facts and the theory was noticed independently by Fajans and the writer.

Characteristics of the alpha-ray bulb as a source of ionisation: D. C. BARDWELL and H. A. DOERNER. For the corrections involved in Part III, a knowledge of the characteristics of the alpha-ray bulb as a radiator, as affected by the tip and neck, by the thickness of the wall and obliquity of passage of alpha-particles through it, and by the diameter of the bulb (reducing it to zero dimensions in order to afford radiation from a point source) is necessary. In addition, the other corrections applying to the outer sphere itself are treated, such as the dead-arm correction and the change of ionization intensity with the pressure. The recoil atom effect as revised in paper V is also used as a correction for the results, to reduce them to the same conditions as those obtaining outside the alpha-ray bulb, through which recoil atoms cannot penetrate.

A study of the factors influencing the velocity of crystallization (V. C.) of substances from supersaturated solutions: JOHN D. JENKINS and JAMES H. WALTON. An apparatus for the determination of very rapid crystallizations by following the process with a dipping refractometer immersed directly in the crystallizing solution has been devised and described, and a large number of runs made to determine the effect of the addition of various substances upon the V. C. of naphthalene and urea from their solutions in methyl alcohol. The results of those runs have been tabulated. The ability of a substance to affect the V. C. seems to be a very specific property. A thermometric method of measuring the V. C. of substances in various solvents has also been worked out and the apparatus and method described. It consists in inoculating a supersaturated solution with a known weight of standard seed crystals and measuring the rate of rise of temperature of the rapidly stirred solution in a thermally isolated cell. The constants are calculated from the curve this obtained after correction for radiation and heating due to the stirring of the solution.

Measurements of the V. C. of three solutes, urea, acetanilid and ammonium nitrate have been made by this method in various solvents and mixtures. The results of this investigation show that the important factor in the V. C. of these substances from such solvents and mixtures is the viscosity of the medium. The relation between the velocity constant, K, and viscosity is given by the equation—$KS = A/\eta$, where $0.57 - \eta$ is the viscosity of the solution, A is an arbitrary constant depending upon the solute, and S is the surface area of the crystals per unit volume of solution. The results of these experiments have been discussed in relation to some of the present theories and the inadequacies of some of these pointed out. Berthoud's formula—$dc/dt = (DS)/(\delta + D/K)\ (C_0 - C)$—was shown to fit the facts better than any of the others. The temperature coefficient of the V. C. of acetanilid in several solvents has been determined and found to be due only to the decrease in viscosity of the medium at the higher temperature.

Heterogeneous Catalysis. I. The selective action of catalytic nickel in the hydrogenation of certain vegetable oils: A. S. RICHARDSON, C. A. KNUTH and C. H. MILLIGAN. The previous literature on selective hydrogenation is reviewed, and new data are presented to show that the hydrogenation of cottonseed, peanut and soya bean oils with use of nicked catalyst is characterized by the preferential conversion of linolic acid to oleic acid and its isomers. The selective character of the hydrogenation of these oils appears to be more marked with use of increasing amounts of catalyst and with increasing temperature up to an optimum in the neighborhood of 200 degrees C. The experimental results favor the view that intermediate adsorption compounds are formed between catalyst and unsaturated components. The nature of these adsorption compounds is discussed.

The catalytic activity of certain metals prepared by the reducing action of adsorbed hydrogen: L. H. REYERSON and KIRK THOMAS. Hydrogen, adsorbed by porous substances such as silica gel, reduced to the metallic state ions of the following metals, silver, gold, copper, platinum and palladium. Of these platinum, palladium and copper, supported by the silica gel, showed marked activity as catalysts in hydrogenation. At 0 degrees C. the palladium catalyst converted 95 per cent. of the ethylene used to ethane. At the same temperature the platinum catalyst converted 65 per cent. of the ethylene and at room temperature the copper catalyst converted 5 per cent. of the ethylene. These values represent averages, and they were obtained on passing the mixed gases through the catalyst once at a moderate rate.

Concerning zinc perchlorate: D. L. RANDALL. This salt, which was first mentioned by Serullas in 1831, has been little described in the literature. It was prepared by treating zinc carbonate with perchloric acid. On evaporation and cooling in a desiccator over fused calcium chlorid long needle-like crystals were formed. On analysis the results indicated the formation of the hexahydrate. The salt which is very soluble will deliquesce in a moist atmosphere but in a dry atmosphere will return to its crystalline form.

A further study of the sulfides and selenides of ammonium: A. S. KING and C. R. MCCROSKY.

Fluosilicic acid III, titration and properties: C. JACOBSON. Schucht and Möller's (ber. 39, 3693, 1906) method has been improved. The acid is titrated with normal NaOH in two stages, by first adding an excess of a neutral salt like NaCl. The first stage titration takes place at five degrees or below, in concentrated solution, using methyl orange as indicator and may be represented by the following equations: $H_2SiF_6 + 2NaCl = Na_2SiF_6 + 2HCl$, $2HCl + 2NaOH = 2NaCl + 2H_2O$. The second stage titration serves as a check upon the first and is represented as follows: $Na_2SiF_6 + 4NaOH = 6NaF + H_4SiO_4$. The results are consistent and satisfactory. The properties such as specific gravity, index of refraction, odor, taste, stability, chemical activity, etc., of a 60 per cent. solution of fluosilicic acid have been recorded.

Solubilities of yttrium salts: B. S. HOPKINS, M. C.

CREW and HILDUR E. STEINERT. The salts used were prepared from the yttrium material purified in the investigation which gave the present accepted atomic weight value of yttrium. A saturated solution was prepared in a thermostat, definite portions withdrawn and the solution weighed in a crucible inclosed in glass stoppered weighing bottle. The amount of yttrium oxide was determined by igniting to the oxide and weighing. From these values the amount of anhydrous yttrium salt in solution in 100 grams of water was calculated. Values were obtained for the chloride, bromide, nitrate and sulfate of yttrium at temperatures ranging from 0 degrees to 95 degrees. The curves were all regular, showing for the chloride a slight increase of solubility with rise of temperature; for the bromide and nitrate somewhat greater increase in solubility and for the sulfate a regular decrease in solubility with rise of temperature. Dilatometer tests showed no change in hydration within the temperatures used.

Electrometric titration of iodate, bromate, chlorate, ferricyanide with titanous salt: W. S. HENDRIXSON. The results show that the halogen oxy-acids can be accurately determined at room temperature, and stopping at the end points; that is, without adding an excess of titanium and titrating back with another oxidizing agent. In the presence of sulfuric acid iodate and bromate show two sharp falls in potential, the first marking the complete destruction of the oxidizing acid and the second the reduction of the free halogen. All these acids give large, sharp rises in potential on adding a few drops of titanous solution at the beginning of the titrations.

The influence of gelatin on the transference numbers of hydrochloric acid: W. H. MORAN and W. G. FRANCE. The transference numbers were measured by the concentration cell method using M/10 and M/100 HCl at 25 degrees. The value for the anion was found to be 0.1699. The addition of gelatin over a concentration range of 0 to 20 per cent. resulted in a change in the value of the anion transference number from 0.1699 to 0.7772. Conductivity measurements of M/10 and M/100 HCl were made over the same gelatin concentration range. In both cases the conductivity was so reduced as to indicate that HCl was removed as a whole from the solutions by the gelatin. The results obtained are in agreement with the prediction previously made by one of us in collaboration with A. L. Ferguson (A. L. Ferguson and W. G. France, *J. Am. Chem. Soc.*, 43, 2161, 1921), in which it was stated that in acids the presence of the gelatin would result in an increase in the transference number of the anion.

The setting of plaster of Paris and its acceleration: HARVEY A. NEVILLE. The setting of plaster of Paris is accelerated by solutions of inorganic compounds and retarded by certain organic substances. The explanation of this as due to the increase (or decrease) in the solubility of $CaSO_4$ by the dissolved substance is unsatisfactory. The acceleration may be considered an example of "catalysis in hydration." The stages in the setting of plaster of Paris are apparently: (1) Absorption by the plaster of all the water in amounts up to four times its weight. A stiff gel is formed and a very slight temperature effect is noted; (2) the gel breaks to form gypsum and free water, most of which gradually evaporates from the pores. Considerable heat is evolved in this stage due to the reaction: $CaSo_4.\frac{1}{2}H_2O + 1\frac{1}{2}H_2O \rightarrow CaSO_4.2H_2O + 3900$ calories. Both the formation and the breaking of the gel are accelerated by inorganic compounds. The retarders act as protective colloids.

Chloroform hydrate and its transition point: ARTHUR E. HILL. The existence of the compound $CHCl_3.18H_2O$, discovered by Chancel and Parmentier, has been confirmed. The compound can be formed by cooling the two components until ice appears, at -0.1 degree; in the absence of ice no compound is formed even on long contact. It is formed only at the interface between chloroform and water, and can not be obtained from either of the saturated liquids alone; the rate of formation is very low. In order to purify it for analysis, it is placed in a desiccator over ice, and maintained at 0 degrees or below; the excess liquid evaporates, forms compound on the ice in the lower part of the desiccator and leaves the stable system, compound-ice-vapor. The compound has a transition temperature into the two nearly insoluble liquids, chloroform and water, at $+ 1.45$ degrees. On warming, however, it shows suspended transformation into the liquids, and may be heated at least as high as 6 degrees before total disappearance. The possibility of superheating depends upon the slowness with which equilibrium is attained in the liquid state, the reactions being first the dissociation of fused compound into its components and second the separation of the liquid into two liquid layers. The phase-rule diagram shows that the compound must possess a metastable congruent melting-point which falls within the two-liquid area. Suspended transformation in a system of this character has not previously been noticed.

The rôle of pectin in gel formation: HARRY N. HOLMES and HARRIET A. HOWE. It seems probable that partial dehydration of hydrated pectin explains the formation of fruit jellies. The sugar acts as a dehydrating agent and the hydrogen ions are probably adsorbed with an influence on hydration. Alcohols take up part of the water from a pectin solution with formation of gels. Glacial acetic acid also takes up water from a pectin solution with formation of gels. So does the proper concentration of phosphoric acid and of hydrochloric acid and of sulfuric acid. A one per cent. solution of pure pectin in hot 0.1 N NaOH gels on standing. Perhaps pectin is a weak acid and forms sodium pectate, well hydrated. Ammonium and barium pectates have similar properties. Barium chloride solutions produce no gels with pectin solution but if a sodium pectate is first formed addition of any soluble salt forms a gel. So does direct addition of barium hydroxide to a pectin solution.

Gel structure: WILLIAM C. ARSEM. The viewpoint presented is that a gel is an intimate mixture of two phases, one solid and the other liquid. The solid phase is pseudo-crystalline. It forms a molecular lattice which differs from a perfect crystalline lattice in that it is greatly expanded and the atoms are not connected at all possible points. A large proportion of the auxiliary

valences are not brought into play except as they may function in holding molecules of the liquid phase. There are thus a great many voids of approximately molecular dimensions which are filled with the liquid phase. A discussion is given of the mutual relations of the sol, gel and crystal states and the conditions for their formation, together with explanations of some colloid phenomena such as swelling and syneresis.

Films: benzene derivatives: William D. Harkins and Elvah Grafton. On account of the fact that the structure of benzene is unknown and since compounds of benzene are in general much more difficult to work with in films on water than the derivatives of the paraffins, practically no experimental work has been done with benzene derivatives. Using as a basis the orientation theory of surfaces, and the plane formula of benzene, Harkins, Davies and Clark in 1917 considered that the area per molecule should increase in the order pyrocatechol, resorcinol and hydroquinone. This is here confirmed experimentally. The area per molecule in square Angstrom units is found to be phenol, 36.6, pyrogallol, 42.7; pyrocatechol, 55.3; resorcinol, 96; hydroquinone (185). The value for hydroquinol is not comparable with the others, since the molecules in the film were not in contact. The surface polarity of these compounds increases in the order; phenol, pyrocatechol, resorcinol, pyrogallol and hydroquinol, and thus increases as the distance between the hydroxyl groups around the ring in the plane formula.

Preparation of manganates and permanganates in liquid ammonia and water systems: H. B. Siems.

A method of determination of the solubility of hydrocarbons in water and the solubility of a few cyclic hydrocarbons at 25° C.: Ernest Bateman and Carleton Henningsen. A method is described for determining the solubility of hydrocarbons in water with an accuracy of at least ± 5 per cent. The method consists essentially of aeration of the saturation solution at elevated temperatures and passing the air and hydrocarbon through a combustion furnace. The solubility of a few cyclic hydrocarbons in water at 25° C. is given as follows: Benzene, 0.190 gms; cyclohexene, 0.020 gms; cyclohexane, 0.0050 gms; toluene, 0.057 gms; mesitylene, 0.0056 gms; durene, 0.0015 gms; and diphenyl, 0.00041 gms per 100 cc solution.

The solubility of some amino and nitro derivatives of benzene in water at 25° C.: Ernest Bateman and Roy Baechler. The paper shows that nitro derivatives of benzene can be reduced to amino compounds up to the limit of their solubility in water. The amino group can then be determined by the usual Kjeldahl method. The solubility in water at 25° C. for nitrobenzene, m-dinitrobenzene, sym-trinitrobenzene, o-nitrochlorbenzene, p-nitrotoluene, o-nitrophenol, p-nitrophenol, o-aminophenol, p-chloraniline and m-nitroaniline are given.

The autoxidation of hydroquinone and the stability of the quinhydrone electrode: V. K. LaMer and Eric K. Rideal.

Studies in photographic sensitivity III. Effect of oxidisers on the sensitivity and on the latent image: E. P. Wightman, A. P. H. Trivelli, S. E. Sheppard. Photographic one-grain-layer plates treated with copper sulfate solution before exposure are desensitized by increasing the "gamma" or slope of the normal exposure portion of their characteristic density-log exposure curves, maximum density being reached at approximately the same exposure for both treated and untreated plates. This is contrary to the effect on the original ordinary commercial plates in which the whole curve is shifted by the $CuSO_4$ treatment. The mechanism of the action in each case is probably dissimilar from the action of chromic acid and other oxidizing agents. The former is likely one of adsorption, the latter an oxidation effect. Some experiments on ordinary Graflex plates, treating the latent image with chromic acid for various lengths of time (exposure time constant) showed a gradual increase in destruction of the latent image, until very little remained on 16 hours treatment. Increasing exposures enormously does not increase materially the densities produced. The results are in agreement with previous work on desensitizing with oxidizing agents.

The size-frequency distribution of grains of silver halide in photographic emulsions and its relation to sensitometric characteristics VI. Photographic densities derived from size-frequency data: E. P. Wightman, A. P. H. Trivelli, S. E. Sheppard. A method of deriving experimentally the densities for any given exposure, in the characteristic H. and D. (density-log exposure) curve of a simple photographic emulsion from its grain size-frequency distribution has been investigated and briefly is as follows: (1) The size-frequency distribution of the grains per unit area (1 cm²) is obtained; (2) the area-distribution of the different sizes of grains are calculated from this; (3) the area-distribution of residual grains after exposure and development is then found in the same way; (4) from (2) and (3) is then calculated the area-distribution of the developable grains; (5) the expansion ratio of developed to developable grains is found and (6) by means of this the area-distribution of developed grains is obtained; (7) the density for any given exposure and class-size of grains is calculated from the formula $D = \log 1/1 - rn\bar{x}$, where r is the expansion ratio, n the number of developable grains of average size $\bar{x}$; (8) a composite density is obtained from the formula—$D = \log 1/1 - (r_1n_1\bar{x}_1 \div r_2n_2\bar{x}_2 \div \ldots \div r_nn_n\bar{x}_n$ and not by simply adding the densities for each class size.

The absorption spectra of 2(phenylazo) phenol and its derivatives: Joel B. Peterson, C. E. Boord and A. W. Smith. Twenty-four derivatives of the "orthohydroxyazobenzene" type were prepared and their absorption spectra photographed in M/15,000 molar solution in 95 per cent. alcohol. The free dyes show a very persistent band in the region 280–380 which is prolonged on the red side almost to 500 for the lower intensities. The p-m-o order of displacement for the mono substituted phenyl derivatives is not evident in this dilution, except for the p-nitro phenyl derivative, which is markedly displaced toward the red. The phenyl, p-chlorophenyl, p-bromophenyl and p-idiophenyl series of derivatives show increasing displacement toward the red in the order given due to the weighing effect. The presence of alkali tends

to suppress the more persistent portion of the band characteristic of the free dye and to develop a new band in the region between 400 and 500. The order of suppression produced by ten moles of alkali per mole of dye is p-m-o for the mono substituted phenyl derivatives, the para derivative being suppressed the least and the ortho derivative the most.

The absorption spectra of phenylazodimethylaniline and its derivatives: DONALD M. COULTER, C. E. BOORD and A. W. SMITH. Twenty derivatives of the phenylazodimethylaniline type were prepared and their absorption spectra measured by the photographic method. The free dyes show a broad band in the general region 520–350 when photographed in M/15,000 molar solutions in 95 per cent. alcohol. The p-m-o order of displacement for substituents in the phenyl nucleus is not evident in this dilution. The absorption bands of the p-nitrophenyl and p-idiophenyl derivatives are markedly displaced toward the red. The presence of acid in the solution tends to broaden and split this band into two narrower bands occupying positions at 280–380 and 420–600 respectively. The band of shorter wave length is suppressed and the one of longer wave length intensified by increasing concentration of acid. The p-m-o order now appears in the intensity or persistence of the bands. In the shorter wave length band the ortho derivative is the most persistent and the para derivative the least. In the longer wave length band the reverse is true. The diethylaniline derivatives show less sensitiveness to acid than the corresponding dimethyl aniline derivative. When the p-methoxyphenyl and p-ethoxyphenyl derivatives are compared the reverse effect is noted.

Azido-dithiocarbonic acid. II. Determination of the acid and its salts: G. B. L. SMITH and A. W. BROWNE. Free azido-dithiocarbonic acid, $HSCSN_3$, may be determined quantitatively by titration with a standard alkali, using methyl red as indicator. The use of methyl orange introduces a slight error in very dilute solutions. The acid and its soluble salts may be determined by titration with silver nitrate, using either the Gay Lussac or a modified Volhardt procedure. An alternative method consists in weighing the silver azido-dithiocarbonate with due precautions to avoid explosion, or in determining the silver content of the precipitate by conversion to silver chloride. In the presence of chlorides, bromides, iodides, thiocyanates and cyanides, the azido-dithiocarbonate radical may be determined under suitable conditions by titration with an alcoholic solution of iodine.

Azido-dithiocarbonic acid. III. Electrometric titration. Equivalent conductivity: G. B. L. SMITH and G. H. BRANDES with A. W. BROWNE. Electrometric titration shows that azido-dithiocarbonic acid is comparable in strength with hydrochloric acid. An indicator changing at pH = 5 is ideal for use in its titration. Conductivity measurements reveal the fact that it is strongly ionized. The equivalent conductivity of the $SCSN_3$ ion at 25 degrees is about 40 as determined by measurements upon the sodium and the potassium salt.

Electrochemical change solutions (by title): HENRY E. ARMSTRONG.

Preparation of manganates and permanganates in liquid ammonia and water systems: H. B. SIEMS. If a permanganate is treated with a strong base in aqueous solution it is reduced to a manganate. Since metallic amides are the bases of the liquid ammonia system, one might expect them to reduce permanganates to manganates. Experimentally, it was demonstrated that all prepared permanganates are soluble in liquid ammonia, and all available manganates are very insoluble in liquid ammonia. Organic and inorganic permanganates were reduced with corresponding amides, using anhydrous ammonia as a solvent. Lithium manganate, which Abegg considered as not capable of existence, was prepared in an aqueous solution. A solution of metallic potassium in liquid ammonia reacted with potassium permanganate to give the manganate. An excess of potassium solution gave manganese dioxide. Permanganates in contact with liquid ammonia undergo decomposition. Anhydrous lithium permanganate in anhydrous liquid ammonia decomposes almost instantly with liberation of heat.

The potential between tri and bivalent titanium: GEORGE SHANNON FORBES and LAWRENCE PERCIVAL HALL. A mixture of $TiCl_3$ and $TiCl_4$ was obtained by heating Ti, 99.9 per cent. pure, in HCl for 15 hours, first at 250°, then at 350°. Excluding air with pure CO_2, it was dissolved and filtered into the cell. Hg– $TiCl_3$ $TiCl_4$ HCl 4n KCl HCl 0.1 n Hg^+. All operations were at 0° C. The E. M. F. rose in 18 hours or less to a maximum, constant for several hours. Total Ti was determined gravimetrically and total reducing power by electrometric titration, giving $TiCl_3$ and $TiCl_2$. Eight cells when recalculated by the logarithmic formula to equal or molal concentrations of $TiCl_3$ and $TiCl_2$ averaged 0.698 ± 0.005 volt. The normal potential, referred to the normal hydrogen electrode at 0° through the temperature coefficients of Lewis and Randall is 0.366 volt when HCl averages 0.05 M and decreases slightly as this increases, probably due to more rapid decomposition of $TiCl_2$.

The effect of water vapor on systems of chlorine-solid potassium iodide and chlorine-solid potassium bromide: L. B. PARSONS and JAMES H. WALTON. When dry potassium iodide or potassium bromide is allowed to stand in contact with dry chlorine gas, no reaction takes place even after several hours. In the presence of water vapor a reaction takes place, the extent of which depends upon the concentration of water in the system. An apparatus was constructed for the study of the effect of different concentrations of water vapor on the reactions between solid potassium bromide and solid potassium iodide with chlorine. With potassium bromide the effect of temperature was also studied. It was found that for each temperature there is a minimum partial pressure of water vapor which must be reached before any considerable reaction takes place between the chlorine and the potassium halide. This minimum effective concentration of water vapor has been shown to correspond to the vapor pressure of a saturated solution of the various constituents of the system.

GRAHAM EDGAR,
Secretary

SCIENCE

VOL. LVIII OCTOBER 26, 1923 No. 1504

CONTENTS

SCIENCE: A Weekly Journal devoted to the Advancement of Science, edited by J. McKeen Cattell and published every Friday by

THE SCIENCE PRESS

Lancaster, Pa. Garrison, N. Y.
New York City: Grand Central Terminal.

Annual Subscription, $6.00. Single Copies, 15 Cts.

SCIENCE is the official organ of the American Association for the Advancement of Science. Information regarding membership in the association may be secured from the office of the permanent secretary, in the Smithsonian Institution Building, Washington, D. C.

Entered as second-class matter July 18, 1923, at the Post Office at Lancaster, Pa., under the Act of March 3, 1879.

THE EDUCATIONAL VALUE OF THE STUDY OF QUANTITATIVE ANALYSIS[1]

How often it has been said that the most important and fundamental instinct of man is the creative instinct, and how many morals have been pointed from this conclusion! This, it may be said, is one of the principal causes for the high degree of development of science and for the advanced state of our civilization. But if this is the orthodox scheme for looking at the matter, I am going to venture a heterodoxy by saying that, quite the contrary, the most primal, fundamental instinct of man is that which prompts him to take things to pieces. If you can remember when you were at the tender age of, say, four to ten years, you will probably recall no greater delight than was given by the opportunity to tear down an old watch, a bicycle or a piece of domestic machinery, to see how it was made and what made it "go." Unfortunately it was not always easy to reverse the process, and the thing would not always go when it was put together again. We are all familiar with the ancient story of the boy who took apart the family clock and who somehow could not get it together again without having a quart or so (I mean a liter or so) of wheels and screws left over. And the small boy often "analyzes" the logic of theory and rules of his elders with the same disconcerting thoroughness, neither he nor his elders being able to piece the thing together again into anything that will "go." Many embarrassing and uncomfortable moments in the family life have resulted from this.

All of which merely gives us a chance again to state that we are, by nature and inheritance, analytical and not synthetical. We want to know of what the universe is constructed and what forces keep it operating. Our greatest minds are devoted to the search for the answers to these questions. It is only a logical consequence and a secondary outgrowth of this passion to know the how and why of things that we utilize the results of scientific search for causes and ultimate forms in the construction or "synthesis" of things having a different outward form and inner nature, and having a wider field of usefulness.

In the analytical laboratory of the college and the university we attempt to direct this useful and un-

[1] Read before the Section on Chemical Education of the American Chemical Society, at the New Haven meeting, April, 1923.

quenchable desire for a knowledge of fundamentals along the lines of orderly and systematic investigation of the composition of things. Possibly it is for this reason that the student often feels that this is the first course in his chemical training that offers any prospect of practical usefulness. He is here, at least, utilizing some of his laboratory effort in the pursuit of semi-practical questions. But as we now gain from the quickened interest taken by the student in his work, we encounter a new difficulty in our attempts to keep the scientific aspects of the subject in their proper prominent relation to the practical bearing of the figures which represent the result of the analysis.

Should the primary aim of the college course in quantitative analysis be to impart to the student the necessary equipment for doing and applying practical work in the industries or to train his mind for logical, orderly thinking, in careful manipulation of the methods of quantitative analysis and in scientific methods of general procedure? To many of us the second purpose would appear to be the more important. Without discounting the fact that the analytical methods should be such as apply, so far as possible, to practical industrial and economic problems, we yet feel that the college should give something more than the mere ability to use such methods to obtain accurate results. The steady trend of college education toward the "practical" has resulted in very strong pressure in favor of the mechanical side. At least in the engineering and agricultural colleges there is commonly a feeling among the students in chemistry that any course in quantitative analysis that is not largely made up of exercises which the individual student will use after graduation is more or less a waste of time. This is, perhaps, a natural attitude and it may even be made unobjectionable if the teacher will recognize the fact that almost any analytical work may be administered in such a way as to emphasize the scientific side of the student's training. Unfortunately, the passion for the practical goes even to the extent of demurring to the suggestion of whatever mental effort may be considered by the instructor as necessary for the proper study of principles. Speaking from a considerable experience in teaching this phase of chemical science, I express the belief that there is no part of the work that is more interesting and, at the same time, more baffling than the problem of causing the student to appreciate the value of the quantitative courses as training of the mind in methods of thought and in attitude toward scientific problems. He is constantly weighing the course in terms of its value as a tool to be used in his expected activities after graduation and he does not readily see that the tool, in this case, is general mental and analytical skill, and not simply the accumulation of a repertoire of laboratory methods. From this comes the impatience to be "getting on," the desire to cover a large field in a superficial way, and the disinclination to stop to weigh and consider. Self training and discipline in accurate thinking and manipulation are foreign to this purpose.

This spirit is sometimes allowed to dominate the planning of the course in quantitative analysis. Comparatively large amounts of time are devoted to laboratory exercises and little or no time to consultations, recitations, lectures or outside reading. The work thus degenerates into what is often aptly described as "cook-book" chemistry, the student acquiring little better than a fairly wide acquaintance with the mechanical processes of quantitative analysis. Students who have transferred from other colleges have sometimes come to me for credit in certain elementary portions of my own courses. Questioning would then bring out the fact that they had already covered more ground than I do in all my courses, but with little or nothing in the line of drill upon principles.

This is not my idea of college work. The student might better acquire his smattering of mechanical processes by serving an apprenticeship in an industrial laboratory, where he would not only become skillful in rule-of-thumb methods of certain practical applications but, at the same time, earn a certain stipend instead of spending.

Then there is another attitude that we have to consider—grown up, to a considerable extent, in these latter days of the remarkable development of so-called "chemical engineering" in the colleges. We are familiar with the fact that American industries have only within comparatively recent years begun to see the real possibilities of chemistry in their own development. This has been reflected in the evolution of curricula in our technical schools, designed to meet the need for chemists who have some knowledge of industrial engineering problems and methods. This has had an effect which is generally good but it has entailed certain results in our colleges which, I imagine, were not entirely foreseen and which are not for the best interests of American chemistry. The result that I have in mind is, first, that the great majority of our young men who are looking to the technical college for chemical training are now drifting toward chemical engineering curricula, rather than toward chemistry as one phase of liberal arts or general science training and, second, that their ambitions are directing themselves to an increasing extent toward positions of an administrative character where, as they suppose, their knowledge of chemistry and of engineering will fit them for directing great enterprises in industrial life. This is a fine and a worthy ambition—for the few who are so constituted as to make success along these lines a hopeful prospect. But a considerable proportion of our chemical engi-

neering graduates are not so constituted, as is shown by a study of the present occupations of the graduates of any good chemical engineering school. Of course a certain fraction of these would not be successful in any field of chemistry and some, indeed, would be failures in any field at all. But if we speak only of those who develop a certain talent in chemical studies, it is unfortunate that we now experience such difficulty in interesting them in the possibilities for productive endeavor, mental satisfaction and high accomplishment in what, for want of a better word, we have been calling "pure" chemistry. They feel that the best that the laboratory has to offer them is an understanding of how the chemist and his laboratory are to be utilized in solving plant problems. They have much less interest in the present need of our American industries for men who have a thorough training in chemistry and in methods of research. Quantitative analysis, to one with such an attitude of mind, is merely a place to stop for awhile to acquire a limited acquaintance with a species of animal which he will later, from behind the mahogany desk, order and browbeat and "fire." He does not realize the value of the quantitative courses as a discipliner of mind and hands and as a necessary preparation for directing the highest type of development in applied science. He is not expecting to be a "laboratory man" and if he tries out some methods of analysis and acquaints himself with the general superficial aspects of laboratory technique, any further training in this work would be mere delay in progress toward more important enterprises. Our difficulty, then, is in finding students who are willing to spend time and effort in convincing themselves, by first-hand experimentation, that chemistry is a quantitative science and that it must be studied as such and; incidentally, to accumulate an extensive knowledge of the methods and applications of analytical chemistry as a necessary basis for almost any use of chemistry, pure or applied. We can scarcely overestimate the value of this study to him who is to make any phase whatever of chemistry his major activity in life. And we may go even farther and assert that a reasonable period spent in the study of quantitative analysis can be made of great value to anyone, without regard to the nature of his major activities, as an education in the orderly methods of study and reason employed in all scientific work of every description. To one who has applied himself to this study for even a semester, especially if he has had proper help from a good teacher, the material world has a new meaning and there is a new respect for the work of men of science everywhere.

The various difficulties here discussed may be overcome if the teacher will persist in his determination to teach the subject as a part of the student's education and not as a mere manual training course. There remains another problem, the serious character of which no teacher of experience will desire to minimize. Shall the laboratory for quantitative analysis be made a place for education and mind development, or a training school for scientific crooks and expert jugglers of figures? It may be either, but I believe that it is possible for teachers of this subject to fail to appreciate to the fullest degree the difficulties involved in entirely avoiding the second alternative. The possibilities for obtaining credit by clever manipulation of figures, ostensibly the results of careful analyses, are exceptionally great in this work. Knowing this, we sometimes are inclined to surround our work with obvious preventives and penalties and to treat all our student reports with suspicion.

This is truly a mistake. If we leave out of consideration that small minority of men without conscience or character who may infest almost any class —men who will readily lie or cheat to gain "credit" or "standing" in a class, it may safely be said that the great majority of our students desire to work honestly and to gain credit and benefit from meritorious work. They make honest reports in most cases but occasionally the temptation to make minor falsifications becomes too great and a slip occurs. Probably the most common case of the kind is where the student runs his analyses in duplicate and finds that the results do not check as closely as he thinks the instructor will require. He may or may not know that some small error has occurred in one of his determinations, but he has reason to believe that neither is very far from the correct result. He reasons that he will gain nothing valuable, either in experience or in knowledge, by repeating the work and he yields readily to the temptation to alter the figures from one or both of the experiments so as to make a report that will be acceptable to the instructor.

There is, of course, the more aggravated case of cheating, where the student makes a pure guess at correct figures without any experimental work at all, or where his guess follows a carelessly performed experiment. This is a form of dishonesty which is usually not difficult to detect, if the instructor has a well-chosen and well-prepared set of samples for student analysis and if he knows accurately the composition of these samples. The student is likely to excuse to himself even this obviously dishonest method on the ground that he has already had his experience, that he will gain nothing of value by repeating the work and that by so doing he will fall behind the class and so possibly lose credit for the course. The fallacy of the first part of this hypothesis is obvious to the instructor, though not to the student.

These and other forms of petty dishonesty are pres-

ent in all (or nearly all) classes in quantitative analysis and there is nothing to be gained by closing our eyes to this fact. We have only to consider how we may minimize these practices, so destructive to all scientific ideals, in the most effective way. In this connection I should like to mention one thing which we should not do and this is to preach to the students about it. No one ever pays much attention to preaching, in church or out of it. We have, it is true, certain reports of sinners brought to repentance by the fiery eloquence of the preaching evangelist but this is mostly an appeal through the emotions and, while some few may possibly yield permanently to this appeal, unfortunately too many others relapse into former chicken-stealing habits the night after the meeting closes. No one pays any attention to preaching except to indulge in the pious hope that this or that acquaintance may profit by it. As teachers we may solemnly warn our students that if they once begin the use of beauty-shop methods for preparing reports they will never be able to do honest, accurate work after graduation (which is absolutely true) but, at the time we are saying this, each student, instead of experiencing any remorse for his own possible infraction of the rules, is feeling in his heart that several others whom he could mention would do well to take home the advice and to profit by it. I have tried this sort of procedure on occasion, and I have no reason for believing that it ever did any good whatever. The real truth is (and our reformers, preachers and teachers of every description would do well to consider this) that one's conscience can be made to approve anything whatsoever that one desires very much to do.

Falsification of analytical records is encouraged chiefly in three ways. These are:

(1) By assigning for analysis materials the composition of which is obvious to the student, so that if pressed for time or if accident has ruined a determination he is too strongly tempted to report data that were not obtained experimentally but calculated from known values. This is the case when pure salts, rather than mixtures or commercial products, are employed for student analyses.

(2) By requiring impossible accuracy in the results of students' analyses. Rather, we should carefully explain at the outset that skill is to be attained only by long and careful practice, that a kind of work that is worthy of the best efforts of men and women of college age and serious purpose can not be done with the highest degree of accuracy when one is trying for the first time and that, while we do not tolerate careless, slip-shod work, neither do we expect from a novice analytical work of a character worthy of an expert. This is a policy of simple fair play with the students.

(3) By creating an attitude of hostility on the part of the student. This applies to all teaching. We well know that even our best students are not likely to do good or honest work in any class in which the teacher is disliked or considered unfair or oppressive in his methods or requirements. Any instructor who assumes an attitude of frowning aloofness—of a taskmaster who is intent only upon getting work done—will very likely be unable to keep in his students the state of mind which is a prerequisite for work of character. On the other hand, if they understand that he desires to be sympathetically helpful, using his experience and more extensive knowledge in assisting his students to a better perception of the possibilities of good work, I am convinced that he has thereby taken a most important step in the direction of reducing the cheating nuisance to a minimum.

In conclusion, let me restate my conviction that the study of quantitative analysis, pursued under proper guidance and in correct atmosphere, may be made of the greatest possible value in the acquisition of an appreciation of chemistry as a quantitative science and of all science as the study of rigid, quantitative principles of nature. And surely it can not be doubted that if all serious minded people could catch something of this sort of appreciation, our progress toward a more orderly, and therefore a more happy, state of civilization would be very much accelerated.

E. G. MAHIN

PURDUE UNIVERSITY

THE YIELD OF WHEAT IN ENGLAND DURING SEVEN CENTURIES

POLITICAL economists agree that the inclosure of open-field farms in the sixteenth and seventeenth centuries was one of the most important economic events of England. It is said that over a thousand books and essays have been written on this subject in an attempt to reach an understanding of the causes which led up to the medieval system of villages and of communal open farms and the principles that underlay the breaking up of the open fields into inclosed fields where individual effort was possible. Quite recently four very interesting articles have appeared on this subject.[1]

[1] V. G. Simkhovitch, "Hay and history," *Political Science Quarterly*, September, 1913; Harriet Bradley, "The enclosures in England: and economic reconstruction," Columbia Studies in History, Economics and Public Law, Vol. LXXX, No. 2, 1918: Lord Ernle, "The enclosure of open field farms," *Journal* of the Ministry of Agriculture of Great Britain, December, 1920, and January, 1921; Reginald Lennard, "The alleged exhaustion of the soil in medieval England," *The Economic Journal*, March, 1922.

In the discussion there is a considerable amount of information bearing upon the subject of soil exhaustion which probably has not come very generally to the attention of our soil scientists because of the character of the journals in which the papers have appeared. Simkhovitch ascribes the principal reason for the change from the open field to the inclosed field system to the deterioration of the soils and ascribes the change and the subsequent improvement of agriculture to the introduction of hay grasses, of the clovers and of alfalfa. He says:

> The introduction of grass seed and clovers marked the end of the Dark Ages of Agriculture. It is the greatest of revolutions, the revolution against the supreme law, the law of the land, the law of diminishing returns and of soil exhaustion.

Miss Bradley appears to agree that the exhaustion of the soil below profitable returns was the cause of the revolution. She does not place much credence on the statements made by other writers that the Black Death was the principal cause nor that it was due to the increased price of wool and to the cupidity of farmers who insisted that the raising of sheep, which was incompatible with open-field agriculture, was the principal cause, nor does she think it was due primarily to the growth of industries.

Lord Ernle in his first paper gives a very interesting account of the general methods of medieval agriculture, of the open-field system, and the historical development of the inclosure of open-field farms. In his second paper he expresses a very decided opinion that soil exhaustion was the main cause of the inclosures. He accepts a statement supposed to have been made by Walter of Henley that in the thirteenth century a yield of 10 bushels per acre of wheat could be expected and then shows by numerous records of yields obtained from the old manuscripts that the yields of wheat in the fourteenth century were around six and a half to seven and a half bushels per acre. He accepts this as conclusive evidence of the exhaustion of soils in the one hundred-year period, due to the loss of plant food from soils which were insufficiently fertilized. He says:

> It was not till the period 1485 to 1560 that the inclosing movement, long in progress, reached a height which alarmed the country. . . . tempted by the high prices of wool, so ran the charge, the land owners, and especially the new ones, evicted the open field farmers from the arable land, meadows and common pastures of the village farms and turned the whole into sheep walks. . . . The evidence collected by the commissions of the sixteenth and seventeenth centuries goes to show that inclosures of whole townships were rare. The period coincides with the breaking up of feudal households, the dissolution of the monasteries, and industrial reconstruction. . . . Between 1577 and 1689 most of the changes which have revolutionized British farming in the nineteenth century were discussed and foreshadowed in agricultural literature. We have, for example, the field cultivation of rape, of trefoil or Burgundian grass and of turnips suggested in 1577. Lucerne followed early in the next century and potatoes in 1664.

In addition, he has to say:

> With arable lands of open fields subject to common rights while fallow, or from corn harvest to seed time, it was impossible to introduce new crops. Rotations were limited and fixed by immemorial usage. No individual could use hand or foot to effect improvements without the unanimous agreement of the whole body of joint occupiers. If one man sowed turnips it would be the live stock of the community that would profit. Better stock breeding was impossible when all the grazing was in common. The difficulties of drainage were enormously increased by the necessity of securing cooperation. . . . What was wanted was a lead, and in the eighteenth century it was given by the land owners. They initiated experiments; and poured their money into the land. Farms were at great cost adapted to modern methods by new buildings, roads, fences and drainage. Much of the land was literally made during the period. A wave of agricultural enthusiasm rose with each decade of the period until at last it swept over the country. The introduction of roots, clover and artificial grasses solved the problem of winter keep. It enabled farmers to carry a larger head of stock; more stock yielded more manure; more manure raised larger crops; larger crops supported larger flocks and herds; which were both better bred and better fed. . . . Inclosure was no longer a question only of social or agricultural advantage; it had become one of economic necessity. The pressure steadily increased in severity. It culminated during the Napoleonic Wars when every pound of food became of national value. At the declaration of peace in 1815 the old system of common cultivation had practically disappeared and the newer system of individual occupation was almost universally installed in its place.

Lennard takes exception to Lord Ernle's view of the exhaustion of soils. He calls attention to the fact that it was not Walter of Henley who made the statement accepted by Lord Ernle that the yield of wheat in England during the thirteenth century was 10 bushels per acre, but that the statement was made in an anonymous paper evidently published about the same time and that the statement evidently referred to what should be and not as to what was. He then gives the yields from 45 estates in the thirteenth century and from 35 estates in the fourteenth century. He admits some doubt as to the statistical correctness of the yields given, as it appears uncertain whether the acreage used was of the year before or of the year of the harvest, that is, the seeded acreage for the following crop. He also says that there is doubt as to whether the yields were reported before or after the tithe was extracted. He thinks the probabilities are that the measure is the measure that came to the farmer and therefore the tenth part that was given

for tithe was not included. Making allowance for the tithe, he estimates the yield in the thirteenth century at six and a fourth to six and a half bushels per acre and for the fourteenth century at seven and a half to seven and three fourths bushels per acre.

He then asks the pertinent question that if, according to Lord Ernle, the yield had dropped from ten bushels in the thirteenth century to between six and seven bushels in the fourteenth century what would the yields have been at the time of the Norman conquest? In conclusion, he says:

> In regard to the problem as a whole I wish to emphasize the fact that I do not profess that the evidence I have brought forward is adequate to prove or even to make probable any positive conclusion. I am not prepared to maintain that the yield of corn improved or even remains steady in the later Middle Ages.

The quotations given above carry sufficient information about the open-field culture that was dominant in England during the Middle Ages and shows how difficult it would have been to have introduced any modifications. The system was rigid and inelastic to an extreme. However or whenever the system of open-field cultivation was started, an attempt was made by the military, monastic and political forces to maintain it for its social advantages long after its economic failure had been realized.

It must be remembered that in medieval times the object was for the people themselves to be satisfied to gain a living from their farms. There was not a large urban population in England at the time. There were few industrial workers at that period who had to be fed. The transportation facilities were execrable, and it was a period and a system under which the least possible crop was removed from the farm. Therefore, soil exhaustion due to the removal of plant food from the soil would have been at its lowest ebb.

It is admitted by every one who has looked into the matter that the system and methods of agriculture in England during the medieval period were very crude and very poor, and that they finally broke down towards the beginning of the seventeenth century when the open-field method gave way to the inclosures and that this period was coincident with the end of the baronial and monastic periods. It is admitted further that from the beginning of the seventeenth century methods of agriculture began to improve with a consequent increase in the yield per acre of wheat.

It is highly desirable that, through diligent research into old manuscripts, reports and commissions' investigations, the yields per acre for each of the centuries be as accurately determined as possible to establish the level of agriculture under the medieval system and the rate of increase under the more intelligent methods used since then.

The political economists have given a great deal of attention to the yields in the thirteenth and fourteenth centuries, which marked the beginning practically of written records. They have succeeded in establishing a number of more or less accurate figures for these two centuries, but they have not given us yields in the fifteenth, sixteenth and seventeenth centuries. It is admitted by them that there is probably a wealth of information to be obtained by any one who will take the trouble to search the records of those three centuries, and this should by all means be done, preferably by some one in England who can obtain access to these old figures through the libraries and through baronial and monastic records and Parliamentary reports of many inquiries that have been made from time to time into the state of agriculture.

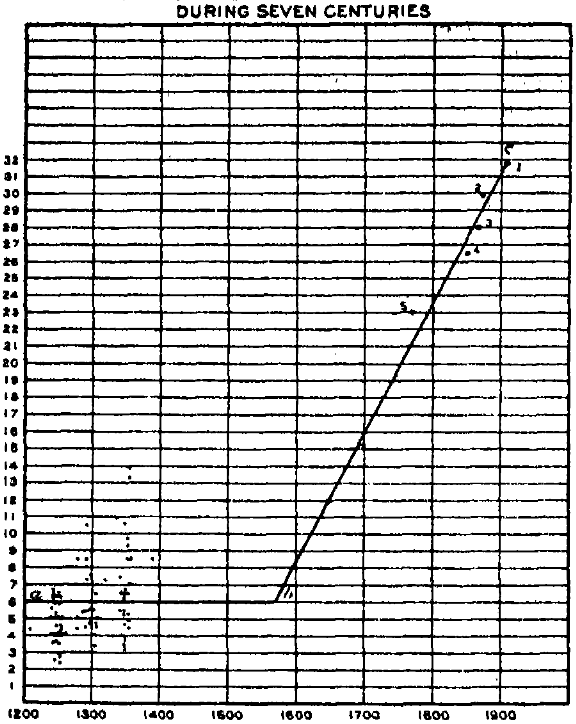
In the following figure I have drawn a line a—b—c which appears to me to furnish a reasonably satisfactory basis to represent in a crude way the yield of wheat per acre during these seven centuries.

I have indicated on this figure the 45 yields given by Lennard in the thirteenth century and the 35 yields which he gives for the fourteenth century. The average yield of the thirteenth century without allowance for tithe is five and one fourth bushels. The average for the 35 yields in the fourteenth century is six and three fourths bushels. I have considered that under the circumstances this difference of one and one half bushels between the two centuries may be considered as insignificant and I have therefore drawn the line a—b approximately midway between five and one fourth and six and three fourths and have taken an average of six bushels per acre.

Starting with c on the line b—c we have the average of the official British figures for 1909–1913 as given in the year book of the United States Department of Agriculture for 1922. The second dot is the figure determined as the average yield per acre in Great Britain in 1873 by the International Statistical Congress at St. Petersburg which arranged to have the average yields of the principal countries determined. The third dot is an estimate by Sir James Caird of the average yield of wheat in England for 1868. The fourth dot is an estimate of Sir James Caird of the yield in 1850, the fifth dot is the estimate of Arthur Young of the average yield in England in 1770. I have inserted a dot at 1650 indicating a yield of 12 bushels per acre, as it is my impression that the yield of wheat per acre in England at that time was around that figure. From here the line is extended until it meets the line a—b at about the year 1570.

The lines a—b and b—c of course do not meet at the point b at an angle, but the two lines should be connected with a curve, the form or radius of which can not be determined without a sufficient number of figures. As drawn, the line b—c has a slope of about eight bushels per one hundred years, or an increase of one bushel in twelve and one half years.

YIELD OF WHEAT PER ACRE IN ENGLAND DURING SEVEN CENTURIES



It seems to me that a horizontal line somewhere around the average yield of six bushels per acre will probably be found to be a very satisfactory basis of the yield of wheat with the method prevailing under medieval conditions and that if we could establish the facts this same level could have been extended back for a period of a thousand years during which time the methods and system of agriculture had not materially changed.

During the whole of the medieval period in England, life was comparatively simple. There were few people whose occupations required them to be fed by labor other than their own; there was a very small proportion of urban population. There was little or no trade in agricultural products within the kingdom or with neighboring states on account of the difficulties of transportation. There was no necessity and little opportunity for the production of large crops. There were a few thoughtful men as there are in all ages who were dissatisfied with conditions, who thought they could be bettered. The early English agricultural writers, such as Tusser and Fitz Hubert, were thundering for reforms, but reforms only came when necessity drove, when in the sixteenth and seventeenth centuries the urban population increased, the industrial age began and the lack of sufficient food for the non-producers caused bread riots and the demand for inclosures where individual effort could be rewarded. Not until then was the old system finally swept away to give place to the new.

As the inclosure system began to prevail over the open-field system, the introduction of grasses, of clovers, of lucerne, of turnips and of potatoes became possible. Drainage began to be installed where needed. The selection of seed, the rotation of crops, the improvement of cattle, sheep and hogs, the improved implements, the improved transportation facilities and above all human and personal desires and aspirations, the use of marls and of guanos and later the introduction of bones and of commercial fertilizers made possible a better system of agriculture which has tended steadily to increase the yield per acre of wheat.

The introduction of these improved methods had little or no effect upon the average yield of the country until the methods had permeated and affected the practice of a large proportion of the farmers. With a million men engaged in agriculture, the combined labor of all making up the average, it was not until the methods had been adopted and intelligently used by a majority of the million farmers that the average yield of the country could be materially increased. So it is reasonable to expect that when we obtain sufficient figures the line b—c down to somewhere near the point b and extended over three centuries will be a nearly straight line with no jogs which could be attributed to the introduction of clover, or to the improvement of livestock, or to the introduction of fertilizers, for these methods spread but slowly through the mass of farmers, the efforts of whom in the mass make up the average.

Let us look at the probabilities of the line a—b at the six bushels level with the methods employed under the medieval system of agriculture. Thorold Rogers, from the records of Merton College, shows that in 1334, 1335 and 1336 the yields on their estate at Gamlingay were respectively, six, seven and one half, and three and one tenth bushels. In the same years the average yields per acre of wheat on their estate at Cuxham were 15.1, 15 and 15.2 bushels per acre. He considers these yields higher than the average, because during this period the price of wheat was lower than the average of the periods before and later, indicating a relative abundance of wheat in these years and consequently a relatively high yield per acre. From the figures furnished by Lennard the yield ranges from about two and one fourth bushels per acre to as much as 14 bushels per acre with an average for the two centuries of somewhere around six bushels per acre or, with an allowance for tithe which may have been deducted, six and one half bushels per acre.

The average yield of wheat in the United States forty-odd years ago was around 12 bushels per acre. It is now in the neighborhood of 15 or 16 bushels per acre. There are some six million farmers

at the present time, a large proportion of whom are raising wheat, which affects this average in proportion to what they produce. Is it not safe to assume that a considerable proportion of our farmers are using methods that yield them about the same returns as the farmers of England obtained under medieval systems of agriculture? Have we not, all of us, seen examples of a tenant farmer with insufficient capital, with poor and decrepit livestock, without ambition or adequate training, use methods not unlike the medieval methods and by injudicious cultivation, by inefficient methods, bring down the yields of even our better farms to a level of the yields obtained by the medieval farmers of England?

On the unfertilized wheat plot at Rothamsted the yield of wheat has declined to an average of about 12 bushels per acre. If this plot had been cultivated with insufficient capital, with half-starved animals and if the weeds had not been rigorously subdued by a laborious system of hand-picking, the yield of wheat on this plot would probably have come down to the yield of wheat under medieval conditions and with a much more rapid decline than has actually been experienced. It is safe to say that in a period of five years on most of the soils of the United States the yield of wheat could be brought down to the yields obtained under medieval methods in England if those same methods and conditions were revived now in this country. It does not take centuries to impair the productive power of soils. It requires only a few years of the life and effort of a man to lower the level of productivity to that of the medieval English farmer.

On the other hand, many of the long-time fertilizer and rotation experiments of modern times have shown that in a period of from five to fifteen years through intelligent methods yields equal to the present English yields can be obtained by the individual farmer. They have obtained these larger yields by rotations alone, by the application of fertilizers alone, or with a combination of fertilizers and rotations.

These things are well known and yet with all of our experience and all of our knowledge we must consider that these improved methods must be adopted by a large proportion of our farmers before they sensibly affect the average yield of the country.

So it seems to me that the low average yield in medieval times must be ascribed to the methods, to the system, rather than to any loss of plant food from the farm and that the increased production of England to-day must be ascribed to the methods, system, and to the higher average intelligence of the man who works the soil.

If, by further research of the political economists or the soil experts, the line b–c is found to be substantially correct or if on the average in the past three hundred years the increase in wheat production is shown to have been around one bushel in twelve and one half years the question may well be asked: What are the possibilities of the future and where is the end to the possible production of the soil? To answer this I can only refer to King's statement in his study of the agriculture of China that he himself measured the yield of wheat on a field cultivated by a Chinese farmer and determined that the yield per acre was 117 bushels and that in traveling through the province he saw many fields that yielded as much or more. Whether we can ever attain such yields as these Chinese farmers have secured or whether, if it were possible, it could ever be economically done under the general economic conditions of the world is another question; but so far as I can see the limit of possible production even for the average farmers in England has not yet been reached. While the world can obtain wheat at low cost from countries where the yield is low because of primitive methods but where vast quantities of the grain can be secured for the international markets, the question of increasing our yields is dependent upon economic conditions; but we are concerned here only with the possibilities of wheat production—with the maximum yield that may be obtained, and in weighing the evidence for or against soil exhaustion, as this term is usually understood.

MILTON WHITNEY

BUREAU OF SOILS,
WASHINGTON, D. C.

THE GEOGRAPHICAL DISTRIBUTION OF MEMBERSHIPS IN THE NATIONAL ACADEMY OF SCIENCES

THE geographic distribution of membership in the National Academy of Sciences is a subject which has interested me for several years. At my request Dr. Aitken has prepared for SCIENCE the tabulations of membership distribution in the academy, as set down below, on the basis of states in the Union, and of universities, colleges and research institutions. Three members of the academy are at present residing outside of the continental area of the United States—at Manila, P. I., at Arequipa, Peru, and at Freiburg, Germany; these have been credited respectively to Washintgon, D. C.; Cambridge, Massachusetts, and Chicago, Illinois, in the several tabulations. The number of members assigned to the individual states or institutions may be in error here and there to the extent of one member, because changes of address may be unknown to us; but these possible defects can scarcely affect the significance of the tables.

MEMBERSHIP IN THE NATIONAL ACADEMY OF SCIENCES BY STATES

New York	41	Pennsylvania	4
Massachusetts	39	Ohio (Cleveland district)	4
Washington, D. C.	27	Rhode Island	3
Illinois	23	Michigan (Ann Arbor)	2
California	21	Missouri (St. Louis)	2
Connecticut	18	Arizona (Flagstaff)	1
Maryland	14	Indiana (Bloomington)	1
New Jersey	8	Iowa (Iowa City)	1
Wisconsin	8		
		Total	217

MEMBERSHIP IN THE NATIONAL ACADEMY OF SCIENCES IN INSTITUTIONS OF LEARNING

Harvard University	27	University of Michigan	2
University of Chicago	17	Northwestern University	2
Yale University	17	Washington University	2
Columbia University	15	Case School of Applied Science	1
Johns Hopkins University	13	University of Indiana	1
University of California	8	University of Iowa	1
Princeton University	7	Vassar College	1
Stanford University	7	Carnegie Institution	9
University of Wisconsin	7	Smithsonian Institution and National Museum	8
Cornell University	6	Rockefeller Institute	6
University of Illinois	4	U. S. Geological Survey	5
California Institute of Technology	3	Bureau of Standards	3
University of Pennsylvania	3	American Museum of Natural History	2
Brown University	2	U. S. Department of Agriculture	2
Clark University	2	Miscellaneous	32
Massachusetts Institute of Technology	2		
		Total	217

If on the map of the United States a broken line be drawn from Salem, Massachusetts, on the Atlantic Coast through Schenectady, Ithaca, Pittsburgh and back to the Coast through Washington, D. C., the area defined will contain the residences of 154 out of the 217 members of the academy, or 71 per cent. A broken line from Cleveland through Ravenna (Ohio), Bloomington (Indiana), Urbana (Illinois), Chicago, Madison and Ann Arbor will enclose the residences of 38 members, or 17.5 per cent. A line in California starting at Berkeley, and passing through Palo Alto, Mt. Hamilton, Pasadena and ending at La Jolla will carry 21 members, or 10 per cent. Only 4 members are left to represent the remainder of our country: 2 at St. Louis (Missouri) and 1 each at Flagstaff (Arizona) and Iowa City (Iowa); in other words, excepting 21 members in California there are only 4 members living west of a north and south line drawn through Madison (Wisconsin). There is no member in the part of the country lying east of the Mississippi and south of a line drawn from St. Louis through Bloomington (Indiana), Pittsburgh and Washington, D. C., and there is no member in the three New England States north of Massachusetts. Six states and the District of Columbia contain 183 members, and 10 states contain the remaining 34 members; 32 states out of the 49 divisions have no members.

It should be said that the policies of the National Academy of Sciences have limited its memberships to representatives of the physical and biological sciences, with very few exceptions. The distribution of memberships seems to be worthy of the thoughtful consideration of all who are in any way responsible for the higher educational interests of the nation.

W. W. CAMPBELL

BERKELEY, CALIFORNIA

SCIENTIFIC EVENTS

THE LIVERPOOL MEETING OF THE BRITISH ASSOCIATION[1]

THE meeting of the British Association which concluded on September 19 was in many ways notable, and marked the successful introduction of various changes in the local and scientific proceedings. In point of numbers it was the third largest meeting (Australia in 1914 excepted) in the long history of the association, but the actual number of tickets taken is not the only criterion for success. Figures are, however, of some value; for one of the objects of the association, namely, to spread knowledge of science and what it stands for, can be most successfully accomplished by an appeal to the public receiving ready response.

While the membership numbered 3,296, not less than 15,000 people attended the free public lectures in Liverpool and the surrounding boroughs, while more than 7,000 paid admission to the Scientific Exhibition held under the auspices of the association in the Central Technical School on September 10–22, and this number does not include members of the association itself, who were admitted free.

Further, the sectional meetings were almost all not merely well attended but often overcrowded, a condition which spoke well for the enthusiasm for scientific knowledge among the members, but also illustrated the attractiveness of the programs.

The inaugural meeting, when the president delivered his address, was remarkable for the fact that the whole proceedings were broadcasted, and in two halls in Liverpool the wireless version was accompanied by lantern illustrations identical with and shown simul-

[1] From an article in *Nature* by Dr. Alfred Holt.

taneously with the originals shown during the address itself in the Philharmonic Hall. The address was well heard in most parts of the British Isles, and was even picked up so far away as Switzerland. This is, indeed, an example of the development of physical science since the last Liverpool meeting held in 1896.

The place of the customary second evening lecture was taken by a most successful scientific soirée given by the local committee at the university. A wonderful series of experimental and other exhibits had been arranged and a most comprehensive program had been prepared, but unfortunately, owing to the awkward lay-out of the university buildings, it must have been nearly impossible for very many of the large and enthusiastic gathering to see properly one half of all the interesting things on view or to hear many of the excellent series of lecturettes. Such a soirée, however, is full of value and was greatly appreciated, and the excellence of all the arrangements at it reflected the greatest credit on all those concerned in its organization.

EXPEDITION FOR THE STUDY OF TROPICAL DISEASES IN SAMOA

According to the London correspondent of the *Journal* of the American Medical Association a new expedition to the tropics for the study of disease is about to start for Samoa under the auspices of the London School of Tropical Medicine. Its main object is the study of filariasis, which affects eighty-five per cent. of the natives of the Pacific Islands. The expedition will be under the direction of Dr. Buxton, a fellow of Trinity College, Cambridge, who is well known for his work in entomology, performed in Mesopotamia during the war, and later as entomologist for the Palestine government in Jerusalem. The expedition will be away for two years and will have its headquarters at Apia. It will work in cooperation with the New Zealand government, which is responsible for the administration of the Samoan group. It is thought that the susceptibility of the Polynesians to disease, especially to tuberculosis, and the decline of their numbers to the extent of threatened extinction, may be due to filariasis. Infection seems to be due to a *Stegomyia* mosquito which is apparently confined to the Pacific Islands. An attempt will be made to eliminate the disease by exterminating the mosquito on lines similar to those that were adopted in Panama and other places. It is thought that the problem is comparatively simple, as the mosquito lives in and around coconut trees and is found in the empty coconut shells, which are stacked in the making of copra. It is proposed to take over a small island a mile or so in diameter, where every breeding place of the mosquito will be effectively dealt with. The native method of storing water is in artificially hollowed coconut trees. It is proposed to substitute, for these, properly constructed cisterns. Moreover, the mosquito does not seem able to exist where the dense undergrowth has been properly cut down. If airways or rides are cut through the dense jungle and the insect is exposed to the trade winds of the Pacific, it may be blown away. An object lesson of this kind can then be applied to the larger islands. Other parasitic diseases prevalent in Samoa, particularly ancylostomiasis, will also be studied. Finally, the effects of the tropical climate on Europeans will be investigated more minutely than has been done previously. The finer methods available since the recent development of biochemistry will be used. Thus, the effect of the sun's rays on the human skin will be investigated with the catathermometer. As an expert ornithologist and entomologist, Dr. Buxton also hopes to bring back a collection of birds and insects (many of which are becoming extinct) for the British Museum.

THE ADJUSTMENT OF AUTOMOBILE HEADLIGHTS

The Bureau of Standards is conducting work on the better adjustment of automobile headlights. In addition to that carried out locally in the District of Columbia, the bureau is sponsoring a national movement to secure headlight adjustment. A representative of the bureau emphasized the importance of the member club activity in this matter at a meeting of officials of the National Motorists Association in Cleveland, September 20, 21 and 22. This association and the American Automobile Association, as well as all similar organizations, are in a particularly favorable position to place before motorists the necessity for headlight adjustment. The problem has also been discussed in the broadcasting programs which the American Automobile Association sends out through radio station WRC.

The National Automobile Chamber of Commerce is calling the attention of motor car manufacturers to the necessity of closer supervision of their dealer and service activities so that the two or three million new cars turned out annually will have properly adjusted headlights. The Motor and Accessory Manufacturers' Association has made a similar offer to get in touch with headlight manufacturers to insure the furnishing with all headlight devices of simple and adequate instructions for their adjustment. The Society of Automotive Engineers is giving active support through its Standards Committee, particularly along the lines of standardizing and improving headlight construction.

If all headlights could be focused in the same manner, this would simplify the instructions required and facilitate adjustment. In fact, any action taken which may make adjustment easier will be a step forward.

All the national associations approached have

stated that they would actively back a national campaign for headlight adjustment, and some states already have such campaigns under way. Action of this sort should be given all possible support, since proper road lighting will not only reduce the number of accidents, but will make night driving more agreeable. If headlights are adjusted now, a mass of restrictive legislation will be avoided later on.

PROFESSOR COOLEY AND THE ENGINEERING COUNCIL

THE resignation of Mortimer E. Cooley, dean of the College of Engineering and Architecture of the University of Michigan, as president of the American Engineering Council of the Federated American Engineering Societies, was announced at the opening session of a two-day meeting of the Executive Board of the Council held in Rochester, N. Y., October 12.

Dean Cooley, in presenting his resignation to the board, said that he retires on account of ill health. He also made it known that he has been granted leave of absence by the University of Michigan for the second half of the academic year 1923–1924. The executive board adopted a resolution expressing regret that Dean Cooley is forced by ill health to relinquish the presidency of the Federation. The resolution, the adoption of which followed the expression of tributes by leading members of the board, and which was in the nature of an address to Dean Cooley, follows:

Every member of the Executive Board of the American Engineering Council whose deliberations you have led and guided for the past two years listened with the deepest regret to your announcement of the necessity of laying down the duties of the office of president of the Federated American Engineering Societies at the close of this year. Could any reassurance of our support of you and your policies have changed that decision, such assurance would have been at once unanimously tendered.

You took the responsibilities and burdens of our leadership at a most trying hour and in our behalf you have sacrificed both time and health.

With a life-time already devoted to the unification and upbuilding of our profession, you were our outstanding choice to assume the responsibilities of the guidance of our policies. Our faith in you has been more than justified. Coming to us at a time when our organization was almost unknown and of little influence, through your personal prestige and because of your clear vision of the possibilities of service and achievement by a united profession, the Federated Societies have now reached an unassailable position of dignity, respect and public confidence.

For all this and for the steadfastness with which you have revealed your vision to us and to our profession, we thank you.

Though consoled by your promise to still be with the work of the Federated Societies, we shall miss your leadership and something more. Your geniality has been infectious, your sense of humor has relieved many a potentially critical situation, your optimism has brushed aside many difficulties, but above all your personality has drawn us to you and inspired affection. And we shall always be eager for your advice and counsel.

SOCIETIES MEETING AT CINCINNATI

THE following named societies have informed the Washington office of the American Association for the Advancement of Science that they will hold sessions at the approaching Cincinnati meeting, next convocation week. The names and addresses of their secretaries are also given below:

American Mathematical Society (Chicago Section)
Arnold Dresden, 2114 Vilas St., Madison, Wis.
Mathematical Association of America
W. D. Cairns, Oberlin College, Oberlin, Ohio.
American Physical Society
Harold W. Webb, Columbia University, New York, N. Y.
American Meteorological Society
Charles F. Brooks, Clark University, Worcester, Mass.
Association of American Geographers
Richard E. Dodge, Connecticut Agricultural College, Storrs, Conn.
National Council of Geography Teachers
George J. Miller, State Teachers College, Mankato, Minn.
American Society of Zoologists
W. C. Allee, University of Chicago, Chicago, Ill.
Entomological Society of America
C. L. Metcalf, University of Illinois, Urbana, Ill.
American Association of Economic Entomologists
Albert F. Burgess, Melrose Highlands, Mass.
Wilson Ornithological Club
Gordon Wilson, 1434 Chestnut St., Bowling Green, Ky.
Botanical Society of America
I. F. Lewis, University, Va.
American Phytopathological Society
R. J. Haskell, U. S. Department of Agriculture, Washington, D. C.
American Society of Naturalists
A. Franklin Shull, University of Michigan, Ann Arbor, Mich.
Ecological Society of America
A. O. Weese, James Millikin University, Decatur, Ill.
American Microscopical Society
Paul S. Welch, University of Michigan, Ann Arbor, Mich.
American Nature-Study Society
Anne Botsford Comstock, 123 Roberts Place, Ithaca, N. Y.
Metric Association
Howard Richards, 156 Fifth Ave., New York, N. Y.
American Society of Agronomy
P. E. Brown, Iowa State College, Ames, Iowa.
American Society for Horticultural Science
C. P. Close, College Park, Md.
Potato Association of America
William Stuart, U. S. Department of Agriculture, Washington, D. C.

Association of Official Seed Analysts
A. L. Stone, University of Wisconsin, Madison, Wis.
Society of Sigma Xi
Edward Ellery, Union College, Schenectady, N. Y.
Gamma Alpha Graduate Scientific Fraternity
H. L. Borst, Ohio State University, Columbus, Ohio.
Phi Kappa Phi Fraternity
C. H. Gordon, University of Tennessee, Knoxville, Tenn.
Phi Delta Kappa Fraternity
Abel J. McAllister, 2118 West 109th St., Chicago, Ill.
Pi Mu Epsilon Mathematical Fraternity
E. D. Roe, Jr., Syracuse University, Syracuse, N. Y.
National Association of Teachers of Speech
H. B. Gough, DePauw University, Greencastle, Ind.

SCIENTIFIC NOTES AND NEWS

Professor Henry Fairfield Osborn, with Mr. Roy Chapman Andrews and other members of the Third Asiatic Expedition of the American Museum of Natural History, left Shanghai for America on October 17.

Professor Douglas Johnson, of Columbia University, who was selected by the seven cooperating institutions (Harvard, Yale, Columbia, Cornell, Pennsylvania and Johns Hopkins Universities, and the Massachusetts Institute of Technology) as exchange professor to France in engineering and applied science for 1923–24, sailed on October 18 to spend the winter lecturing at eight or ten of the principal French universities.

Dr. Herbert E. Gregory has returned from Honolulu to resume his duties as professor of geology at Yale University. During the summer he visited scientific institutions in New Zealand and served as delegate to the Pacific Science Congress in Australia.

The National Civil Service Reform League proposes an investigation by Congress of the removal of Arthur Powell Davis as director of the Reclamation Service.

The Leonard Prize of $500 for research work in X-rays has been given by the American Roentgen Ray Society to Dr. William Duane, professor of biophysics at Harvard University, for his researches in X-ray spectra and methods of estimating the dosage of X-rays to be used in treating diseases.

The honorary degree of doctor of agriculture of Berlin University was conferred during the past summer on Professor John A. Mandel, of New York University, who was also made an honorary member of the Institute for Experimental Therapeutics at Frankfurt a/M. (Paul Ehrlich Institute) and of the Physiological Society of Berlin.

The University of Chicago has received a portrait, executed by Mr. Ralph Clarkson, of President James Rowland Angell, of Yale University, who was for twenty-five years professor of psychology at the university and for nine years dean of the faculties. The portrait will be hung in the dining room of the Quadrangle Club.

Dr. Wilhelm Ostwald, professor of physical chemistry at Leipzig, reached the age of seventy on September 2.

A special volume of the *Zeitschrift für Kristallographie* has been published in honor of the eightieth birthday of the founder and first editor, Professor P. von Groth.

The Medical Society of London has awarded the Fothergillian Medal and Prize to Sir Arthur Keith.

Professor Bergonié, of Bordeaux, and Dr. Calmette, subdirector of the Paris Institut Pasteur, have been nominated grand officers of the Legion of Honor.

Professor G. Araoz Alfaro, of Buenos Aires, has been appointed president of the national board of health, a position he had filled temporarily under the previous administration. He has been given full powers to reorganize his department for the purpose of securing greater efficiency.

Paul M. Tyler, chief of the metals section of the United States Tariff Commission, has resigned.

R. D. Rands, of the Bureau of Plant Industry, Department of Agriculture, who was transferred last June to the department's rubber project, has recently returned from a trip to Central and South American countries, including Trinidad and the Guianas, where he studied the rubber industry and its disease problems. Dr. Rands, who for several years investigated diseases of plantation rubber for the Dutch East Indian Government, also successfully introduced Hevea and other rubber-yielding plants into Panama where experimental work is now under way.

Gerald H. Mains has recently resigned as associate chemist of the Color Laboratory of the U. S. Bureau of Chemistry, to accept a position as a chemical engineer with the Westinghouse Electric and Manufacturing Company.

Dr. Waldemar Pospelov, director of the Bureau of Entomology of the Agricultural Scientific Committee of Russia, arrived in the United States toward the end of September, after having spent a month in England. Dr. Pospelov occupies the position under the present Russian government that was occupied by the late Professor Porchinsky. Before the war he was professor of zoology in the University of Kiew. He comes to the United States to make some studies of methods in economic entomology and to look into the subject of agricultural education. He visited the Bu-

[illegible] Entomology at Washington early in October, and then started on a journey to the midwest, stopping at the Ohio State University at Columbus and the University of Illinois at Urbana. On his journey returning, he will visit Cornell, Harvard, the State Agricultural Experiment Station at New Haven and some of the northern stations of the Bureau of Entomology.

Professor George A. Dean, head of the department of entomology at the Kansas State Agricultural College, has been granted a year's leave of absence to be director of the division of cereal crop insect investigation in the Bureau of Entomology.

Dr. Nuno Guerner, Sao Paulo, Brazil, and Dr. Chang H. Han, Tsinghau, China, have been sent to the United States by their respective governments to study public health under the auspices of the International Health Board.

The International Health Board has awarded scholarships at Johns Hopkins School of Public Health, Baltimore, to five Ohio physicians: Drs. Thomas W. Mahoney, Columbus; Arlington Ailes, Springfield; Clarence D. Barrett, Wooster; Charles Koenig, Toledo, and Roll Markwith, Akron. The scholarships are for one year, and include traveling expenses, maintenance and college fees.

Dr. Arthur L. Day, director of the Geophysical Laboratory and chairman of the Advisory Committee on Seismology of the Carnegie Institution, spoke before the Franklin Institute, Philadelphia, on October 17 on "Earthquakes and Volcanic Eruptions."

Dr. Selig Hecht, of Harvard University, delivered an address on the visibility of the spectrum before the Science Club of Amherst College on October 15.

Professor J. E. Zanetti, chairman of the Division of Chemistry and Chemical Technology, National Research Council, writes: "I have just discovered that, owing to a misprint in the original French minutes of the meeting of the International Union of Pure and Applied Chemistry, the conversion factor 1 cal. 15° = 1.184 joules was translated without correction and appeared in the abstract of the minutes in your issue of September 28, page 241, column 1, line 7. It should be 1 cal. 15° = 4.185 joules."

UNIVERSITY AND EDUCATIONAL NOTES

Bowdoin College has received a bequest of $500,000 by the will of the late Edward H. Blake.

Mrs. Mayer, widow of Levy Mayer, formerly a corporation attorney of Chicago, has given $500,000 to Northwestern University for the erection of a new Law School building. The new building will be named Levy Mayer Hall.

Dr. Henry S. Graves, formerly chief of the United States Forest Service and director of the School of Forestry of Yale University, has been elected provost of the university.

A complete reorganization of the North Carolina State College of Agriculture and Engineering has been largely effected. Five schools have been organized, namely, the School of Agriculture, School of Engineering, School of Social Science, School of Arts and Sciences and the Graduate School. Dr. E. C. Brooks, state superintendent of public instruction, succeeded Dr. W. C. Riddick as president; Dr. B. W. Kilgoré, director of the experiment station and director of extension, became also dean of agriculture. Dr. W. C. Riddick has been elected dean of engineering; Professor B. F. Brown, dean of social science; Dr. C. C. Taylor, dean of the graduate school. Appointment has not yet been made of the dean of the School of Arts and Sciences.

Dr. Harrison R. Hunt recently resigned the professorship of biology at the University of Mississippi to become head of the department of zoology and geology, and member of the Agricultural Experiment Station Staff at the Michigan Agricultural College, East Lansing.

Dr. J. R. Currie, professor of preventive medicine in Queen's University, Kingston, Ontario, has been elected to the newly established Henry Mechan chair of public health at Glasgow.

Dr. Bela Schick, who invented the well-known test for diphtheria susceptibility, has been made an extraordinary professor of pediatrics in the University of Vienna.

DISCUSSION AND CORRESPONDENCE

FILING REPRINTS

Some of my scientific friends have urged that I publish a note on a method of keeping reprints which has proved very satisfactory.

Pamphlet boxes, 10 in. high, 1⅜ in. wide and 7 in. deep, are constructed with a wooden front and bottom, cardboard sides, and open top and back. One gets heavy book "boards" (cardboards) cut at a bookbinders, 7 x 10 in. Then one has pine or white wood stock run off at a mill, dressed to ⅜ x 1⅜ in., and cuts them up oneself into lengths of 10 in. and 6⅝ in. The wood top and bottom are fastened together by two brads, and the cardboards are nailed on to the sides with No. 19, ⅝ in., flat head wire nails. Four nails to a cardboard are enough. When one does so much of the labor oneself, the cost of a box is a little less than five cents. There are similar cloth and card-

board boxes on the market, although they are somewhat wider, which cost thirty cents.

The advantage of the open back and top is to remove any limit to the size of the reprints filed. The shelf dimensions with such a box constitute the only limit. The width of the box is its best feature. It is broad enough to stand alone and to permit labeling on the outside which is easily read with the box on the shelf. (Dennison No. 205 labels can be pasted on the outside.) On the other hand, the box is so narrow that it is very little work for one to go through all the reprints in a single box. For this reason it is not necessary in returning a reprint to the box to remove the other reprints and place the particular one with respect to the others. It is enough for one to know that the reprint is in a given box in order to find it quickly.

The small box also allows readily for the expansion of the series at any point, and for the collection of small groups of papers on a given subject or by a given author into a single repository appropriately labeled.

At present I have about 1,800 reprints filed by author in 210 of these boxes. With this distribution the boxes are not full and there is room for considerable expansion without the introduction of new boxes.

EDWIN G. BORING

HARVARD UNIVERSITY

THE PROFESSOR AND HIS WAGES

UNDER this caption appears an article in SCIENCE for August 24 that well illustrates the danger of theorizing without that judgment and knowledge of "how much" that only experience in the field dealt with teaches.

In the first place, the profits assumed for the merchant are much beyond the average, the orderly progress of success rarely exists and the incident worries and troubles and resourcefulness necessary to turn corners are hardly suggested. The risk of capital is quite lightly dismissed. Professor Slosson would doubtless be much surprised to learn that an insurance company, which attempted to underwrite this risk for all those starting in business for themselves, for a 50 per cent. premium, would inevitably bankrupt itself. Yet such is the case.

Of those who attempt business for themselves, even though they have more initiative and self-reliance than the average, fully 90 per cent. are failures and forced to drop out, generally with their capital completely used up. Men, therefore, who succeed in business for themselves, belong to the most severely selected class in the world and certainly not one professor in ten could stick in it. Apply the same severity of selection and the great majority of professors, lawyers, doctors, etc., would drop out, as the majority of business men have. The average professor, then, should not be compared with the successful business man but rather with the latter's employees.

There are, rarely, professors with a genius for teaching—for imparting knowledge—that do work of value hard to estimate and all too little appreciated, and other rare research professors whose work is of inestimable value. These, unhappily, must needs be ill rewarded, largely because but few can appreciate their work or appreciate it during the life-time of the men. Unless a bit sensational, it makes small appeal to the public. But as for the majority, like the great majority of other classes, they get all they are worth to the community. But few of these audible books benefit the community as much as average clerks because their efforts are not directed and coordinated from outside as are those of the clerks.

FRANCIS RALSTON WELSH

NIRVANA, DEVON, PA.

SCIENTIFIC BOOKS

Eighth Report[1] *of the Committee for the Investigation of Atmospheric Pollution. Reports on Observations for the year ending March 31, 1922.* London, 1923.

THE people of London and its environs wash their clothes on Tuesday and themselves on Saturday night. Thus the veil of domestic privacy is ruthlessly torn aside and the secrets of home life no longer held *in camera*. Which is characteristic of this age, for nothing now is hidden. Even the secrets of the structure of matter are pried into, electrons being knocked about by inquisitive physicists; and snug little constituencies known as atoms completely upset and disturbed by some high speed atomic nucleus.

We can prove that the good people of dear old London take their weekly tubbing on Saturday night, because there is a suspicious increase in the number of smoke particles in the air over London at this hour; and these undoubtedly come from domestic fires, lighted or kept going for the purpose of providing sufficient hot water. The Advisory Committee on Atmospheric Pollution have traced such inequalities in the load of suspended impurities to various sources and find that the common dwelling house chimney is the chief offender; even in cities regarded as manufacturing centers. It is not to be wondered at either, for *en masse* these little smokers pour out a vast volume of products of imperfect combustion.

This Eighth Report is the most ambitious effort yet made and shows that the Committee is getting into its stride and obtaining results of great value. The work differs from most pieces of experimental work in

1 Previous reports have been reviewed in SCIENCE, June 2, 1922, April 22, 1921, and November 28, 1919.

chemistry or physics, in that it is carried on, not in a university laboratory, but in the larger laboratory of out-of-doors and the results therefore are applicable without regard to scale and other uncertainties.

The work done during the year falls under eight sections, namely, (1) the monthly amounts obtained by standard gages, tabulated and analyzed; (2) new type of gage; (3) influence of a Nipher wind shield on the amount collected; (4) the Rochdale deposits; (5) the automatic filter; (6) a jet apparatus for the isolation and examination of atmospheric dust; (7) researches on obscurity and visibility; (8) relations with other organizations.

Thirty-one gages were operated during the year, of which 8 were in London. Data are now available for five years, in many cases, and so comparisons can be made with a view of getting monthly or seasonal departures from mean conditions.

The old unit for amount of deposited matter, namely, the metric ton per square kilometer, has been altered to simplify printing. The amounts heretofore given to two decimal places have been multiplied by 100 and can be read as metric tons per hundred square kilometers and the same figures express the weight in grams over 100 square meters. The gram per square dekameter, $gm/(10m)^2$, seems to be a practical and economical unit.

The year was one of exceptionally fine, clear weather; and also there was a coal strike from April 1 to July 4. The amounts of pollution are below the average and the influence of the coal strike can be clearly traced.

An interesting point brought out by the Rochdale experimental records, is that the impurity of the air is not particularly due to an influx from neighboring polluted areas. By means of twin gages, one collecting material brought by east winds and the other by west winds, it is shown that the high deposit at this place is not due to impurities carried into town by the west wind.

Again during the stoppage of coal and the closing down of factories, duplicate gages made it plain that factory smoke was responsible only for about 66 per cent. of the pollution.

A rough estimate is

Dust 15 per cent.
Factory smoke 66 per cent.
House smoke et al. 19 per cent.

Many interesting graphs are given showing conditions on foggy and non-foggy days.

There is a detailed description of the new jet apparatus dust counter of Dr. J. S. Owens, an instrument which is within reach of the laity.

Near the end of the Report there is a handy bibliography of dust investigations.

ALEXANDER MCADIE

SPECIAL ARTICLES

THE INFLUENCE OF THE TEMPERATURE OF THE SOIL ON THE RELATION OF ROOTS TO OXYGEN

THE rate of root growth of land plants, under normal conditions of aeration, is known to be influenced by the temperature of the substratum in such manner that there are three well defined temperatures of growth, namely, the highest at which growth is possible, the temperature at which growth is most active, and the temperature below which growth ceases. Under conditions of a diminished supply of oxygen, however, these cardinal temperatures of growth appear to be greatly modified. This feature has physiological and ecological bearing of some interest.

In *Potentilla anserina,* which occurs in swampy ground, with the roots in 1.2 per cent. oxygen and the balance nitrogen, the growth of the roots is various. Thus at 27° and 30° C. growth does not take place, but at 18° it is about one fourth normal for that temperature. When given experimental atmosphere containing 2 per cent. oxygen the growth rate is about one fourth normal at 30°, one third normal at 27° and normal at 18° C.

In a garden variety of corn with roots in 3 per cent. oxygen the effect on the rate of growth is quite as striking as in the case of Potentilla. For example, at 30° it is about one sixteenth normal, 20° it is about one fifth normal and at 18° it is about one third normal. When the percentage of oxygen is increased to 3.6 the rate of growth is much increased. For example, at 30° the rate is about one third the expected rate under normal aeration conditions, while at 18° it is about two thirds normal. While in 10 per cent. oxygen the rate at 30° is about nine tenths normal and at 18° it is normal.

In the two species referred to, and the same is true of several species studied, the relative rate of root growth, that is, the rate under given oxygen conditions as compared to the expected rate in normal conditions of aeration, decreases with the increase in the temperature of the soil. It can be seen, therefore, that there comes a point in the diminution of the oxygen content of the soil atmosphere when the growth of the root ceases because it is no longer sufficient to supply the demands for energy correlated with physiological activities of higher temperatures. The diminution of the oxygen supply of a consequence becomes a factor limiting the growth of the root, and which, as the above citations indicate, may have specific value.

Some observations on modifications of the cardinal temperatures for root growth resulting from deficiency of oxygen indicate that the conclusion as stated in the preceding paragraph may in some manner in-

fluence such as well. Thus the maximum temperature for root growth of *Opuntia versicolor* is about 42° under normal conditions of aeration, but when the percentage of oxygen is reduced to 1.2 no growth occurs at 30° although it may go on at 20°. This being the case, both the optimum as well as the maximum temperature for growth are greatly reduced.

The optimum temperature for the growth of the shoot in corn is about 33.7° and the maximum temperature is about 46.5°, while the corresponding temperatures for the root are probably somewhat less. In percentages of oxygen less than 10, and except as indicated above, and for soil temperatures below 30°, the growth rate is below normal. However, in 3.6 per cent. oxygen the most rapid growth rate is about 30°, but when the amount of oxygen is reduced to 3 per cent., 20° is apparently about the optimum temperature for growth.

Observations on the relation of the roots of the Rough lemon to the oxygen supply at relatively low soil temperatures indicate that the minimum temperature under certain conditions may also be modified. The Rough lemon has apparently a fairly high minimum temperature for root growth, or at least the rate of growth under normal conditions of soil aeration is relatively slow at 18° C. In 2 per cent. oxygen, however, although growth continues at 26° and at 22°, it does not go on at 20° or at 18° C. In this instance the minimum temperature for growth may have been raised.

The observations above summarized on the relation of root growth to the oxygen supply are apparently in accord with the known variation in the respiratory ratio (of the shoot) which is associated with differences in temperature, being least at those that are medium, that is 15° C., or less.[1]

The ecological bearing of the influence of the temperature of the soil on the oxygen relation of roots can only be suggested. The ecological significance of soil aeration has been referred to in an earlier paper[2] and it need merely be suggested in this place that the oxygen relations of the species with especial regard to the temperature of the soil should also be taken into account. It is quite clear from the summary above given of typical results in relation to several species, and which can probably be extended to other species as well, that in puddled soils with consequent poor aeration, and in summer, the matter of oxygen supply to the roots must be acute. And, in certain species, as, for instance in varieties of corn, in order to attain to a fair rate of root growth at a time of high soil temperatures the aeration of the soil must be good indeed, otherwise, as shown in another paragraph, the rate of growth is very considerably cut down.

The conclusions arrived at and as reported in this notice offer additional reasons for extensive studies on the temperature-aeration relations of the soil, and suggest the desirability of intensive investigations on the oxygen relation of roots as an important physiological factor of ecological moment.

W. A. Cannon

Coastal Laboratory,
Carmel, California

[1] Palladin's "Plant Physiology," Livingston, p. 190.

[2] "The Ecological Significance of Soil Aeration," W. A. Cannon and E. E. Free, Science, N. S., Vol. 45, p. 178, 1917.

DISPERSITY OF SILVER HALIDES IN RELATION TO THEIR PHOTOGRAPHIC BEHAVIOR

In a recent article appearing in the *Journal of Physical Chemistry*, 27, 1–51, Wightman, Trivelli and Sheppard report that in general the larger the silver halide grain and the larger the range in grain size in the emulsion, the more rapid the paper in its action towards light. The authors support their conclusions by means of exhaustive research by means of photomicrographs. There can be no doubt that in the case of their experiments "the relative speed of the emulsions increases rapidly with the increase of average size and range of size of the particles contained therein." However, that this is not always the case is shown by the example quoted in the Eastman Monograph No. 1, p. 104, written by Trivelli and Sheppard, where comparison of two emulsions showed that the one having grains one third the linear dimensions was more than 19 times as fast and that the same was true of individual grains in the same emulsion. Koch and Du Prel (*Physik. Zeit.*, 17, 536 (1916)) conclude that it is not possible to formulate a definite relationship between the grain size and sensitivity with the information at present available, but that it is certain that the largest grains in an emulsion are by no means the most sensitive.

Theoretical consideration: On the basis of the nuclear theory, the speed should depend on the *number of grains affected*, on the basis of the sub-halide theory, the speed should depend on the *amount of halide* affected. From both the continuous wave theory and the quantum theory of light the number of grains affected or the amount of halide affected should increase with the dispersity. Theoretically, then, the smaller grained emulsions should be more sensitive.

Discrepancy between the results of Wightman, Trivelli and Sheppard and the theoretically expected results is perfectly explained by adsorption. Adsorption increases with specific surface, the latter increasing with dispersity. The retarding effect of the adsorbed halide might neutralize or completely reverse the purely dimensional effect. With much adsorption we should expect the sensitivity to be inversely proportional to the adsorption or inversely proportional to the dispersity. Hence the larger-grained

emulsion would be more sensitive. The effect of range of size can also be explained by adsorption as the small grains adsorb relatively more soluble halide than the larger ones, leaving the larger ones relatively freer and therefore more sensitive than if the small ones had not been present.

Experiments performed in this laboratory show that large-grained emulsions are more sensitive when unsensitized, but that after sensitization the relative speeds are reversed. The sensitization process used is one of removing adsorbed retarding halide. We are forced to conclude that intrinsically small-grained emulsions are faster; that adsorbed halide may neutralize or reverse the purely dimensional effect so that where there is much adsorption the large-grained ones seem the faster; that unless one knows not only the ratio of size of the grains, but also relative amounts of adsorbed retarders, it is impossible to predict the relative speeds of two emulsions.

The above investigation is at present nearing completion, and the complete results will be published in the near future.

Frank E. E. Germann
Malcolm C. Hylan
Dept. of Theoretical and Physical Chemistry, University of Colorado

THE AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE

THE LOS ANGELES MEETING

The seventh annual meeting of the Pacific Division held in conjunction with the fourth annual meeting of the Southwestern Division and the summer session of the American Association for the Advancement of Science at Los Angeles from September 17 to 20, 1923, was from every point of view a pronounced success.

While the various eclipse expeditions of the preceding week had in most cases been somewhat disappointing on account of weather conditions, yet the occasion of the eclipse had drawn together many distinguished astronomers from all parts of the world and their assemblage under the auspices of the Pacific Division was a dominating feature of the Los Angeles meeting.

The symposium on "Eclipses and Relativity" on the opening day of the meeting proved to be a very attractive feature of the general sessions and was largely attended.

The Research Conference, held at the luncheon hour on Monday, September 17, was participated in by practically the entire convention and the following program was presented:

Research activities of the California Institute of Technology: Professor Earnest C. Watson, California Institute of Technology, Pasadena.

The Scripps Institution: Acting Director F. B. Sumner, Scripps Institution for Biological Research, La Jolla.

The causes of variation in yield in citrus trees: Acting Dean Herbert J. Webber, University of California Agricultural Experiment Station, Riverside.

Petroleum research: Dr. Laird J. Stabler, University of Southern California, Los Angeles.

On Monday evening, September 17, the meeting was formally opened with an address of welcome by President von KleinSmid, of the University of Southern California, to which response was made by Dr. C. E. Grunsky, chairman of the executive committee.

The address of the retiring president, Professor E. P. Lewis, of the University of California, was then delivered. Dr. Lewis chose as his subject: "The contributions of astronomy to civilization," thus further emphasizing the astronomical character of the Los Angeles meeting. He gave a masterly survey of the progress of astronomical knowledge from the earliest times showing that the race has benefited not only materially but ethically and spiritually through the labor of astronomers. He held out the hope that through the discoveries of Einstein and others some of the most illusive problems of space and time may be brought within the range of human comprehension. As a notable contribution to a popular understanding of these abstruse questions the publication of this address in Science will be welcomed.

Wednesday evening, September 17, Dr. John C. Merriam, president of the Carnegie Institution of Washington, spoke on "The meaning of history as illustrated by the records secured at Rancho La Brea." The perfect preservation of the specimens entrapped in the asphalt beds of La Brea and the wonderful succession of life represented constitutes a unique historical record and furnishes indubitable proof of the evolution of existing species from these remote types. It is hoped that Dr. Merriam will arrange the substance of this interesting address for publication.

Dr. R. B. von KleinSmid, president of the University of Southern California, gave an interesting discourse on the "Psychology of Crime," a subject in which he has specialized for many years. It was a notable addition to the program provided for the general sessions.

Too much can not be said in praise of the very efficient preparations made for the meeting by the local committees. The accommodations for the various meetings of the affiliated societies were all that could be desired and the courteous hospitality extended to visitors was the occasion of much favorable comment.

Over 500 registered for the meetings, including 253 members of the association. Twenty-three affiliated societies held meetings under the auspices of the Pacific Division. Reports of some of these meetings,

as submitted by their secretaries, will be printed in SCIENCE.

W. W. SARGEANT
Secretary, Pacific Division American Association for the Advancement of Science

JOINT MEETINGS OF THE AMERICAN ASTRONOMICAL SOCIETY, THE ASTRONOMICAL SOCIETY OF THE PACIFIC, AND SECTION D OF THE AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE

ON the first day, September 17, the sessions were held at the University of Southern California, Los Angeles; on the second day, in Pasadena—in the morning, at the office of the Mount Wilson Observatory, and in the afternoon, at the Norman Bridge Laboratory of the California Institute of Technology, in conjunction with the physicists; on the third day, in the dome of the 100-inch Hooker telescope on Mount Wilson.

There was throughout a large attendance of professional and amateur astronomers. Eastern and western observatories in the United States were well represented, and in addition there were astronomers from Canada, Mexico, Australia, Japan, Argentina, England, Spain, France, Belgium and Holland.

The symposium on eclipses and relativity on the afternoon of the first day attracted a large audience. There were four addresses, as follows:

Some conditions apparently existing in the solar corona: DR. W. W. CAMPBELL, president, University of California.

How the spectrum of the sun's atmosphere is studied at eclipses and the interpretation of the results through the aid of modern physics: DR. S. A. MITCHELL, director, McCormick Observatory, University of Virginia.

The constitution of the sun's atmosphere, the levels of the gases and the nature of their circulation. Results bearing on the displacements of solar spectrum lines as required by the theory of relativity: DR. CHARLES E. ST. JOHN, astronomer, Mount Wilson Observatory, Pasadena.

Relativity as represented by the Einstein-eclipse problem: DR. R. J. TRUMPLER, assistant astronomer, Lick Observatory, Mount Hamilton.

The last two speakers dealt with the bearing of recent observations on the theory of relativity. Dr. St. John's paper contained the important announcement that an exhaustive discussion of wave-lengths of lines in the solar spectrum has led him to the conclusion that the pressure in the reversing layer is negligible, and that after the effects of radial motion and scattering have been eliminated there remain differences between solar and laboratory wave-lengths of the order called for by the Einstein theory. Dr. Trumpler explained in detail the good agreement found on the Lick Observatory plates of the 1922 eclipse between the measured displacements of stars near the sun, and those predicted by the theory of relativity. Results obtained at the eclipse of September 10, 1923, were reported by Professors Brackett, Worthington, Miller, Douglass and Gallo.

About one hundred and thirty persons made the trip to Mount Wilson on the third day. Most of them remained until evening to look through the 60-inch and 100-inch telescopes.

The technical papers presented at the various sessions were as follows:

Some vagaries of refraction: ARTHUR J. ROY, Dudley Observatory.

Recent latitude results at Lick Observatory: R. H. TUCKER, Lick Observatory.

Notes on proper motions: A. VAN MAANEN and HANNAH M. MARSH, Mount Wilson Observatory.

Fundamental consideration on researches relating to minor planets: A. O. LEUSCHNER, University of California.

Radial velocities of stars of spectral class R: R. F. SANFORD, Mount Wilson Observatory.

Hypothetical parallaxes of 135 A double stars measured at three or more epochs: R. G. AITKEN and MARGARET POWELL, Lick Observatory.

The radial velocities of long-period variable stars: PAUL W. MERRILL, Mount Wilson Observatory.

Some properties of the stars in space as derived from the near-by stars: W. J. LUYTEN, Harvard Observatory.

A new catalogue of variable stars: S. D. TOWNLEY, Stanford University.

Three stellar spectroscopic notes: W. S. ADAMS and A. H. JOY, Mount Wilson Observatory.

A possible origin of the nebular lines: H. H. PLASKETT, Dominion Astrophysical Observatory.

The possibilities of instrumental development: GEORGE E. HALE, Mount Wilson Observatory.

On Atmospheric Absorption: H. L. VANDERLINDEN, Observatoire Royal, Uccle, Belgium.

The sun's action on the magnet, a note on variable stars and cosmic clouds: LUIS RODÉS, Observatorio del Ebro, Spain.

The radiation from mercury compared with the radiation from other planets: EDISON PETTIT and SETH B. NICHOLSON, Mount Wilson Observatory.

Asymmetry in the distribution of stellar velocities: GUSTAF STRÖMBERG, Mount Wilson Observatory.

Stellar interferometer work during 1922–1923: F. G. PEASE, Mount Wilson Observatory.

Density distribution in the photographic images of elliptical nebulae: EDWIN HUBBLE, Mount Wilson Observatory.

Radial velocity measurements of the spectrum of omicron ceti: ALFRED H. JOY, Mount Wilson Observatory.

On account of lack of time the following papers were read by title:

The systematic corrections to Boss's preliminary general catalogue: William B. Varnum, Dudley Observatory.

Jupiter's third satellite: W. H. Pickering, Harvard Observatory Station, Jamaica.

Relativity: An approximation: Charles Lane Poor, Columbia University.

The number and distribution of stars with Class B spectra having emission lines: Ralph H. Curtiss, University of Michigan Observatory.

Progress with color-index apparatus: Edward S. King, Harvard Observatory.

Methods and results of the absolute magnitude determination of stars at the Dominion Astrophysical Observatory: W. E. Harper and R. K. Young, Dominion Astrophysical Observatory.

The spectral parallaxes of double stars: Frederick C. Leonard, University of California.

Mean absolute magnitudes of the long-period variables and other stars of late types: Ralph E. Wilson, Dudley Observatory.

Atmospheric pulsation of cepheids, a method of attack: W. Carl Rufus, University of Michigan Observatory.

Remarks on the luminosity function: F. H. Seares, Mount Wilson Observatory.

On the orbit of the brighter component of Beta Lyrae: R. A. Rossiter, University of Michigan Observatory.

The absorption lines of O-type stars: J. S. Plaskett, Dominion Astrophysical Observatory.

Regularities in the arc spectrum of Zirconium: C. C. Kiess and Harriet Knudsen Kiess, U. S. Bureau of Standards.

An Arctic episode in astronomy: R. H. Tucker, Lick Observatory.

Two new camera lenses for spectrographs: J. S. Plaskett, Dominion Astrophysical Observatory.

The orbits of the spectroscopic components of Boss 6148: W. E. Harper, Dominion Astrophysical Observatory.

The orbit of the spectroscopic binary Boss 1458: W. E. Harper, Dominion Astrophysical Observatory.

The wedge method and its application to astronomical spectrophotometry: H. H. Plaskett, Dominion Astrophysical Observatory.

Photo-electric photometry at the Washburn Observatory: Joel Stebbins, University of Wisconsin.

The radial displacements in the Wallal photographs: William B. Varnum, Dudley Observatory.

Regularities in the spectrum of titanium: Henry Norris Russell, Princeton University.

Abstracts of the papers will be published as usual in *Popular Astronomy.*

Joel Stebbins
Secretary, American Astronomical Society

AMERICAN METEOROLOGICAL SOCIETY

One of the largest and most interesting meetings of the American Meteorological Society was held at the University of Southern California, on September 17, 18 and 19. The meeting was held conjointly with those of the Pacific and Southwestern Divisions of the American Association for the Advancement of Science and our Society enjoyed all the privileges obtained by the larger societies. The first session was devoted largely to evaporation problems and it was brought out in the discussion that none of the methods used were entirely satisfactory to engineers. Dr. George F. McEwen closed the discussion by stating that he believed the Calculation Process to be best for large bodies of water, whereby an equation based on isolation is used. Later Mr. Charles E. Grunsky offered the following resolution, which was passed with no dissenting votes:

Resolved, that the study of evaporation from open bodies of water should be extended, with particular references to the standardization of methods of observation, in order that known meteorological conditions may better serve as a basis for predicting evaporation losses from such water bodies.

The next session was largely devoted to the discussion of the problems of the Lower Colorado River as caused by mountain snowfall and flood crests. The discussions were unusually interesting as the problem is an international one. The people of the United States have spent great sums—five or six million dollars—on a project located in Mexican territory, for the purpose of conserving water for use in our country as well as in Mexico. Resolutions were passed covering this problem as follows:

Being impressed with the importance of flood control and other problems of the Lower Colorado River and the necessity for an early solution thereof, and realizing that the solution of these problems requires action by the United States because of their interstate and international aspects, be it resolved by the American Meteorological Society that the attention of the Executive Committee of the Pacific Division of the American Association for the Advancement of Science be called to the present situation with the suggestion that the Pacific Division place itself on record as favoring early action by the United States to accomplish the permanent solution of these Colorado River problems.

The third session was taken up in discussing matters pertaining to forecasting the weather, and Mr. L. E. Blochman brought to light some interesting facts regarding the probabilities of long range forecasting based upon the geographical location of low pressure areas entering the United States from the Pacific Ocean.

The morning session of the last day was made most interesting by the presence of two aviators, Messrs. Wyatt and Lawing, from the Air Field at San Diego, who flew to Los Angeles that morning in a plane

especially prepared for taking meteorological observations while aloft. These men left their station in San Diego for Los Angeles at about the same time the other members of our society left their hotels for the meeting place at the University of Southern California. They arrived promptly at 9 a. m. and gave most interesting talks regarding upper air conditions over the southwest portion of California, based upon almost daily observation taken during the last two years by these gentlemen.

The afternoon session, which concluded the series, was specially devoted to the influences of weather upon forest fires. It was brought out at this meeting that humidity was even more important than wind in starting, spreading and stopping forest fires.

It was proved that the United States Weather Bureau could be of great help in forewarning fire-fighters of dangerous conditions and the following resolution was submitted and passed unanimously:

WHEREAS, the conservation of the remaining forest area and the reforestation of large areas already cut over are largely dependent on the prevention and control of forest fires, and

WHEREAS, in the prevention and control of forest fires a fore-knowledge of the weather is most important, and

WHEREAS, the making of weather forecasts for forest areas is difficult, because most of the observation stations are outside these areas; therefore be it

RESOLVED, that the Congress be asked to appropriate such funds as are needed to provide meteorological stations in the forest areas and to make adequate study of forest weather and to apply the results of this study to forest fire prevention and control.

Votes of thanks were given to the Pacific Division of the American Association for the Advancement of Science and to the University of Southern California for the conveniences afforded the meetings of our society. After which it adjourned *sine die*.

E. A. BEALS,
Secretary pro tem.

THE AMERICAN PHYSICAL SOCIETY

THE one hundred and twenty-second regular meeting of the American Physical Society was held in the Norman Bridge Laboratory of Physics, California Institute of Technology, Pasadena, on September 18, 1923. The morning session was a session of the Physical Society alone, and the afternoon session was a joint session with the American Astronomical Society. The attendance was about sixty. The presiding officer was Professor E. C. Watson.

Papers presented at the morning session and those contributed by the Physical Society to the afternoon session were as follows:

The physical characteristics of diplacusis: V. O. KNUDSEN and GEO. E. SHAMBAUGH, University of California, Southern Branch.

Interference phenomena with a thick glass plate in the path of one of the interfering beams: W. N. BIRCHBY, Norman Bridge Laboratory of Physics, California Institute of Technology.

On the condition known as electrical neutrality: FERNANDO SANFORD, Stanford University.

A method of comparing the rates of mixing of two liquids: L. E. DODD, University of California, Southern Branch.

The crystal structure of benzene: JARED KIRTLAND MORSE, Ryerson Physical Laboratory, University of Chicago.

Oscillograms of the barkhausen effect: S. R. WILLIAMS, Norman Bridge Laboratory, California Institute of Technology.

Magnetic results obtained by the Carnegie during cruises IV, V and VI: J. P. AULT, Carnegie Institution of Washington.

Accurate measurements of the energy content of extreme ultraviolet mercury lines, and the precise determination of the photoelectric long-wavelength limit of a clean surface of mercury: C. B. KAZDA, Norman Bridge Laboratory, California Institute of Technology.

Effect of temperature and surface impurities on photocurrents with aluminum surfaces from which surface films have been removed by melting in vacuo: J. REED NIELSEN, Norman Bridge Laboratory, California Institute of Technology.

Magnetic beta ray analysis of soft x-rays: JOSEPH A. BECHER, Norman Bridge Laboratory, California Institute of Technology.

The pulling of electrons out of metals by intense electrical fields: R. A. MILLIKAN and CARL F. EYRING, Norman Bridge Laboratory, California Institute of Technology.

The appearance of certain ghosts in the general x-ray spectrum formed by reflection from calcite; an explanation of their cause and the means of their elimination: A. E. HENNINGS, Stanford University.

The influence of the scattering substance on the wave length and intensity of scattered x-rays: P. A. ROSS, Stanford University.

JOINT SESSION WITH THE AMERICAN ASTRONOMICAL SOCIETY

Effects of a total solar eclipse on the earth's magnetic and electric fields: J. P. AULT, Carnegie Institution of Washington.

Photographic film characteristics in the ultraviolet: GEORGE R. HARRISON and CEDRIC E. HESTHAL, Stanford University.

Extreme ultraviolet spectra: R. A. MILLIKAN and I. S. BOWEN, Norman Bridge Laboratory of Physics, California Institute of Technology.

The vacuum spark spectrum of calcium: J. A. ANDERSON, Mt. Wilson Solar Observatory.

Series spectra in oxygen and sulphur: J. J. HOPFIELD, University of California.

D. L. WEBSTER,
Local Secretary for the Pacific Coast

SCIENCE NEWS

PERIODICITY OF INFLUENZA

Science Service

FURTHER evidence of periodicity in outbreaks of influenza is afforded by a recent increase in the number of cases of the disease in London and other English cities, according to Dr. George W. McCoy, director of the U. S. Hygienic Laboratory. But the recurrence of the disease in England does not necessarily mean an epidemic.

The reports from overseas stated that the first increase in the number of cases of influenza in English cities was noted during the third week in September. This was nearly 33 weeks from the date of the last outbreak there, a period which is coming to be associated with revivals of the disease. This period was first observed by Dr. Brownlee, statistician of the British Medical Research Council, and it has been recently confirmed by the health authorities of Liverpool.

Commenting on these reports, Dr. McCoy said: "There is much evidence for a recurrent periodicity in influenza epidemics for a period of some years following a general world epidemic such as was experienced in 1918–19. This period seems to be close to eight months or 33 weeks from the beginning of one epidemic to that of another, although irregularities sometimes occur. This is particularly true if a recurrence is due during the warm months. In such a case only a few cases are usually noted and no real epidemic develops. For example, the 33 weeks period since the outbreak of the last epidemic here ended late in August, but there has been no outbreak. The next date for recurrence if the period holds good is late next spring, but the lateness of the season will probably prevent much of an outbreak."

Dr. McCoy called attention to a periodicity in epidemics of other infectious diseases such as measles and scarlet fever.

"It has been found in New York," he said, "that measles is much more prevalent on alternate years, while for scarlet fever the period seems to be four or five years. Why this is so we do not know."

Some medical authorities in England have hazarded a guess that influenza recurs periodically and spontaneously in some individuals who have suffered from the disease and have cited the outbreak of the disease on ships which have been long at set as favoring such a theory, but it has as yet not found general acceptance.

LABORATORY WORKERS AND INFECTIOUS DISEASE

Science Service

Two cases of Malta fever, a highly infectious but seldom fatal disease and one very rare in this country, have occurred among the laboratory staff of the U. S. Public Health Service Hygienic Laboratory, where the disease is under investigation. Both patients are now convalescent.

Goats are subject to the disease, and a few months ago there was an outbreak of it in Arizona in sections where unpasteurized goat's milk was extensively used as food. Doctors and workers from the Hygienic Laboratory were sent to the spot and after quelling the outbreak returned to Washington where further inquiry as to methods for the prevention and cure of the malady were undertaken. The two cases among the laboratory workers followed.

Malta fever, as its name indicates, was formerly very prevalent on the island of that name and to a less extent throughout the whole Mediterranean basin where goats' milk is a staple food. While rarely fatal, it causes disability for long periods in many cases, convalescence being interrupted and tedious.

The two cases of this disease among workers in the Hygienic Laboratory calls renewed attention to the risks run by the doctors and scientists there who handle deadly germs with the same indifference to danger that is shown by workers with high explosives. Not long ago there were six cases in the laboratory of a rare disease known as tularemia. Rabbits and other small mammals have been found to be infected with this disease which is easily transmitted to human beings, causing a long continued fever and prolonged disability, although the death rate is practically zero. So infectious is this disease that practically every laboratory worker who deals with it catches it sooner or later.

In a more serious class is the deadly Rocky Mountain spotted fever, a disease which because of its prevalence in parts of the northern Rocky Mountain region has caused the abandonment of settlements and ranches and serious loss of life and property. Cattle are subject to it and it is usually transmitted to man through the bite of a certain species of tick. The mortality in man runs from 50 to 90 per cent.

Although it has already killed several workers in the U. S. Public Health Service, the Hygienic Laboratory is on its trail, seeking a method of immunization or cure. The work is in charge of Dr. R. R. Spencer, who is regarded by his fellow workers, themselves used to dealing with such unpleasant diseases as plague, smallpox and typhus, as literally on the firing line of science, for the unseen bacteria are more deadly than enemy bullets and give no warning until their victim is stricken down.

FAMINE THREATENS BIRDS OF NORTH

Science Service

FAMINE threatens the animals and birds of the northern forests, if the signs observed by scientific naturalists are to be credited. Creatures furred and feathered, which ordinarily winter in the sub-Arctic wilderness, are working their way southward, seeking food. The long-continued drought is held responsible for extraordinarily small crops of evergreen cones, which are a chief dependence of the winter birds and the squirrels. Moreover, a scarcity of mice and rabbits is suspected.

As a consequence of these conditions the small birds are moving, and the owls are following them. The fierce goshawk, the great gray Arctic owl and the horned owl, when deprived of a supply of mammals, also turn to the little birds for food, and they, too, promise to descend into regions which ordinarily they never enter. A similar famine several winters ago brought great flocks of small birds, crossbills, nuthatches, pine grosbeaks, tree sparrows, creepers, woodpeckers, purple finches, chickadees, snowbirds, juncoes and other hardy species, which ordinarily find living easy in the icy wilderness northward. They were much in evidence in the country neighborhoods and in the suburbs and parks of New England cities. They were accompanied by the owls and the goshawk, which levied toll on the henyards and game as well as upon the birds.

Edward Howe Forbush, director of the division of ornithology of the Massachusetts Department of Agriculture, in a statement just issued points out as "a most significant event among the birds" the movement of red-breasted nuthatches, which began in Maine and the Canadian provinces in August and has spread over southern New England and probably farther south. This movement, he says, indicates a scarcity of cones in the north, no doubt the result of a dry season. If this scarcity is a fact, a southward movement of pine grosbeaks, crossbills and other boreal birds may be expected. Mr. Forbush continues:

"Large flights of birds are coming down through northern New England where wild fruits and cones are scarce. They are stripping the wild cherry trees of their fruit. Red squirrels have appeared in numbers in northern Vermont, and are stripping the pine trees of their cones. They are said to have come in from Canada and to be moving southward in search of food. All this as well as an early flight of owls indicates famine in the north. There must be a scarcity of rabbits and of mice in the north. A marked migration of owls has taken place in the woods of northern Ontario. Small owls were seen in the day time and many great horned owls were hooting at night. Since then horned owls have been reported in southern New England."

INVISIBLE METAL WIRE

Science Service

SCIENTISTS at the Bell System Laboratories of the Western Electric Company have found it possible to make gossamer-like metallic strands as fine as 200-millionths of an inch in diameter.

These copper-nickel wires are being used in the construction of the vacuum thermocouple. Practically invisible to the eye as they are, it is found necessary to weld them together under the microscope for enclosure within the minute vacuum bulbs.

The American thermocouple was one of the many "war babies." Prior to the war thermocouples came from Germany. When that crisis involved cutting off the supply from abroad, the Western Electric Company began experimental work.

Thermocouples are required to adjust circuits in the vacuum tube repeaters on long-distance telephone lines. In general these tiny glass bulbs are used to measure the small alternating currents in telephony and radio. The wires made up from a copper-nickel alloy used in fuses to protect the thermocouples are passed through an electrolytic acid bath where they are eaten down to the size desired, it being impracticable to draw wire through dies as fine as is necessary.

Both copper-nickel and tungsten wires are used in this laboratory. The tungsten threads are the smallest of all, being only 200-millionths of an inch thick—a good one hundred of them would be required to make one wire the size of the hair on your head.

Before the development of the electrolytic process, it was exceedingly difficult and expensive to draw the tungsten wire to sizes less than 500 hundred thousandths of an inch in the laboratory. Smaller! smaller! has been the cry until this wire which the eye can hardly discover even under strong light with the aid of a microscope has been evolved and can be produced easily.

MUSIC AND EMOTIONAL EXPRESSION

Science Service

CANNED music is not new; but canned thrills, extracted from canned music and preserved as an aid in the study of human emotion may follow from recent work done by Dr. C. E. Seashore, head of the department of psychology at the Iowa State University. He has been making a study of the expression of emotion in music and concludes that since everything in the way of musical expression that is conveyed to the listener comes in terms of the sound wave, and since these sound waves may be recorded, measured and analyzed by instruments of precision it is possible to get a perfectly accurate record of what the musician conveys.

These factors may then be reproduced separately and their emotional effect combined, making "an approach which is extraordinarily promising for the scientific study of the expression of musical emotion."

It has been found, for example, that the appealing vibrant quality in a singing voice, known to musicians as "the vibrato," is a combined pulsation of pitch and intensity averaging about six oscillations a second. It can, therefore, be expressed in terms of three variable quantities, pitch or frequency of the sound wave, intensity or loudness, and time. Within these three factors all possible variations of emotional expression possible to the vibrato may be found.

A similar method of study may be applied to the emotional effect of timbre which gives the characteristic quality to sounds of all character, and to tempo and rhythm.

The possibility is indicated of the detection of counterfeit emotion through a study, preferably from photographic records, of the voice or musical tone, and here a note of warning is sounded to flirts and flappers. For, says Professor Seashore:

"A tender emotion is a condition of nervous instability. With the objective facts in hand we can correlate the vibrato with principles of neural discharge, showing

SCIENCE

VOL. LVIII NOVEMBER 2, 1923 No. 1505

CONTENTS

SCIENCE: A Weekly Journal devoted to the Advancement of Science, edited by J. McKeen Cattell and published every Friday by

THE SCIENCE PRESS

Lancaster, Pa. Garrison, N. Y.

New York City: Grand Central Terminal.

Annual Subscription, $6.00. Single Copies, 15 Cts.

SCIENCE is the official organ of the American Association for the Advancement of Science. Information regarding membership in the association may be secured from the office of the permanent secretary, in the Smithsonian Institution Building, Washington, D. C.

Entered as second-class matter July 18, 1923, at the Post Office at Lancaster, Pa., under the Act of March 3, 1879.

WORK OF THE NATIONAL RESEARCH COUNCIL[1]

THE National Research Council has had a year of much activity and, as it seems to the secretary, of creditable achievement. The work has been carried on along the lines and by the methods which have gradually come, through experience, to be recognized as probably the most advantageous ones which the council can adopt. These lines of work and methods involve and maintain a very wide contact on the part of the council with the scientific organizations and men of this country and of various foreign countries, these organizations and men representing both fundamental science and its applications. The actual membership of the council, which democratically controls the council's policies and work, is chiefly composed of accredited representatives of more than seventy national scientific and technical societies. Relations with foreign workers and organizations are closely maintained through the International Research Council and its affiliated International Unions, representing different special fields of science. Certain of the National Research Council's special divisions of science and technology are the officially recognized American sections of the International Unions.

Contact with the colleges and universities of the country is maintained by the council especially through its division of educational relations; with the government's various scientific bureaus through the division of federal relations; and with the activities of the various state scientific boards and bureaus through the division of states relations. Relations with the industrial research laboratories of the country, and with applied science in general, are maintained through the council's divisions of engineering, research extension, physics, and chemistry and chemical technology.

The council has been entrusted during the year with the responsibility of expending considerable sums of money given by various foundations, industrial concerns and individuals for the support of various special undertakings in the way of promotion, organization and carrying out of scientific work and research.

[1] Statement of activities for the year July 1, 1922–June 30, 1923, based on a fuller report made to the Carnegie Corporation of New York, from which the Council, through the National Academy of Sciences, derives an annual income.

These will be specifically referred to later in this report. The total budget for the year, not including the money spent in constructing the new building for housing the National Academy of Sciences and the Council, has been about half a million dollars.

New Building

Work has gone forward steadily on the construction of the monumental new building in Washington for the joint use of the academy and the council, and the building should be ready for occupancy in the late autumn of this year (1923). The building is situated on the block of land lying between 21st and 22nd and B and C streets, and faces the Lincoln Memorial. The land was purchased at an expense of about $185,000 provided by gifts from twenty private donors. The total cost of the building and equipment will be about $1,350,000.

Research Fellowships

Perhaps the most outstanding new undertaking of the council during the past year, and that one supported by the largest new gift of money, is the establishment of a series of post-doctorate research fellowships in the biological sciences, including zoology, botany, general physiology, anthropology and psychology. For these fellowships the Rockefeller Foundation has pledged to the council $325,000 to be expended during the five-year period, July 1, 1923–June 30, 1928, no more than $75,000 to be expended in any one year.

These fellowships in the biological sciences, added to those already similarly provided for by the Rockefeller Foundation in physics and chemistry ($500,000 to be expended during six years) and by the Rockefeller Foundation and General Education Board, jointly, in the medical sciences ($500,000 to be expended during five years), constitute a most important addition to the possibilities of actual research work in this country as well as an opportunity for the development of a group of carefully selected, highly trained and eager research workers. The total sum of $1,325,000 available to the council for the maintenance of these fellowships will provide comfortably for the work, for a number of years, of about 100 competent fellows each year.

The selection of these fellows and the general supervision of their work and the administration of the special funds for their maintenance are in the hands of three special boards of eminent scientific men chosen by the council.

Special Conferences

One of the most satisfactory methods used by the council in connection with the promoting, planning and organizing of new undertakings or research projects, especially those in which a considerable cooperative effort is aimed at, is the calling together of special conferences of selected experts from all over the country to meet with officers and members of the council for the consideration of the best methods of attacking special problems and for planning and organizing the research needed in connection with them. Out of such conferences have grown a considerable number of permanent or temporary special organizations, or active major committees which carry on, under the general sponsorship of the council, the actual work of research and organized undertaking.

Among such conferences held during the past year may be mentioned one arranged for by the Advisory Board on Highway Research (November 23, 1922); one on Problems of Human Migrations, with special consideration of the scientific aspects of immigration into America (November 18, 1922); one on Occupational Terminology and Specifications, called by the special request of the Secretary of War (January 6, 1923); one on Vocational Guidance (January 26, 1923); one composed of Scientific Instrument Makers and Users (March 23 and 24, 1923); one on Scientific Bibliography in general and the work of the Concilium Bibliographicum in particular (March 31, 1923); and one of workers in Cattle-breeding (April 27–28, 1923).

Crop Protection Institute

This institute for the promotion and maintenance of research in connection with the insect and plant pests of American crops, which was developed by the initiative and assistance of the council, and comprises a membership of nearly 300 professional economic entomologists, plant pathologists and agricultural chemists, together with representatives of 41 chemical and general industrial companies interested in the manufacture of fungicides, insecticides and apparatus for their use, is now a permanent and self-supporting organization of much vigor and activity. During the past year it has had about $35,000 to spend on research projects and has, in addition, maintained three special research fellowships.

Another scientific institute, similarly set up largely by the initiative and under the sponsorship of the council for the promotion of more scientific methods in the making of chronometers, watches and other related instruments of precision, and known as the Horological Institute, is now on a permanent and practically independent basis, and is showing a praiseworthy activity.

Concilium Bibliographicum

This institution of biological bibliography, established in Zurich, Switzerland, in 1895 by a well-

known American zoologist, Dr. H. H. Field, and which had developed a useful system of prompt bibliographic service in both card and book form for zoologists, anatomists, physiologists and paleontologists, was nearly wrecked by the war and the sudden death of the founder and manager. As about one third of the subscribers to its bibliographic service were American universities, libraries, scientific organizations and workers, it seemed advisable to try to bring special American effort and support to bear on the situation.

The National Research Council, with the financial assistance of the Rockefeller Foundation to the extent of $85,000, has been able to rehabilitate the concilium and to arrange to assist in its maintenance through a period of five years. The concilium, with Dr. J. Strohl, of the University of Zurich, at its head, has been thoroughly reorganized during the past year under the direction of a special commission representing the National Research Council and the Swiss Society of Natural Science, and has nearly caught up with its preparation and distribution of bibliographic references to papers and books published during and since the war.

Union of American Biological Societies

There is nearly a score of major American national biological societies, each representing the interests of a special limited field of biology, but there has been little affiliation or cooperation among them to advance the interests of biology in general. Yet there has been constant need of this, in connection particularly with such general interests as proper means of publication and of the abstracting and indexing of publications and of biological bibliography in general.

The National Research Council, through its division of biology and agriculture, has, on request, interested itself energetically in this matter, and has materially helped in the formation of a Union of American Biological Societies, to which eighteen major societies, including Sections F, G, N and O of the American Association for the Advancement of Science, have now formally given their adherence.

After several preliminary conferences, official representatives of all these societies met in the council's rooms in Washington on April 26 of this year and organized a council of the union and then appointed a smaller executive committee. At this meeting, also, a Joint Publications Committee of the Union and the division of biology and agriculture of the National Research Council made a report on the problem of providing all of biology with adequate abstracting and indexing facilities.

Recent Important Project Committees

Among the recent major committees of eminent important research undertakings is one on research men of science set up to organize and develop on sex problems, composed of members representing the special sciences of biology, physiology, psychology, psycho-pathology and sociology. This committee was organized in 1922 and made a preliminary report on policy and program for its work in March of that year. A sum of $25,000 was made available for the support of the work during the year July 1, 1922–June 30, 1923 by a private donor and the committee has outlined and supported a series of specific investigations during the year, most of which have yielded substantial results. The committee has formulated a program of work for the next two years, which has been assured of financial support to the extent of $50,000 a year.

Another important committee of distinguished membership, representing various fields of biological science and of sociology, has been established by the council for the study of scientific problems of human migrations, with especial regard to American immigration problems. The organizing work of this committee has been supported during the past year by a gift of $5,000 from the Russell Sage Foundation. The committee has carefully prepared an extended program of biological, psychological, sociological and economic special investigations, to carry out which the Laura Spelman Rockefeller Memorial has given $60,000 to the council.

A committee for aiding Russian scientists to obtain American scientific books, journals and papers published since January 1, 1915, was organized by the council, but because of the council's relation to the government through the National Academy of Sciences, was reorganized as a private committee under the chairmanship of the permanent secretary of the council. A cooperative arrangement was established with the American Relief Administration engaged in extensive relief work in Russia under the chairmanship of Honorable Herbert Hoover. By this arrangement all work and expenses of warehousing, repacking, over-sea transportation and final detailed distribution in Russia were assumed by the American Relief Association. Requests were sent by the committee to American publishing houses, government scientific bureaus, national scientific societies and individual scientific men for gifts of scientific publications made since January 1, 1915, with the result that over twelve tons of such scientific publications were received and have been safely sent to Russia and distributed there among the major Russian universities and scientific associations. A host of grateful acknowledgments from Russian scientific organizations and men has been received.

The status and work of various other committees established to plan and undertake research on various problems will be referred to later in this report in connection with reference to the activities of the council's various divisions.

PUBLICATIONS

The council has published thirteen numbers in its bulletin series (major and technical papers usually of considerable length) during the year, and eleven in its reprint and circular series (shorter and usually more general papers). It has now in press five numbers in its bulletin series and two numbers in its reprint and circular series. The total number in the bulletin series is now thirty-one, and forty-three in the reprint and circular series. In addition the council has published a considerable number of miscellaneous papers, of which twenty-five have appeared during the past year.

Among the publications of the year have been an important group (in the bulletin series) prepared by the various special committees of the division of physics, which set out the present status of scientific knowledge in various particular fields of physical science, as magnetism, celestial mechanics, luminescence, atomic structure, acoustics, electrodynamics of moving media, etc. An important study of "Cooperation with the Federal Government in Scientific Work" has been prepared and published at the initiative of the council's division of states relations. Among other important publications of the year is a report on highway research in the United States, being the results of a census conducted by the council's advisory board on highway research in cooperation with the U. S. Bureau of Public Roads. Among the numbers in the reprint and circular series published during the year are two giving important lists of manuscript bibliographies in chemistry, chemical technology, astronomy, mathematics and physics. Also a useful list of research chemicals now manufactured in the United States. Among the miscellaneous papers published during the year is a series of "career bulletins" prepared, at the request of the council's division of educational relations, by eminent scientific men representing different fields of scientific work, setting out the opportunities offered for a scholarly career in each of these fields. These "career bulletins" are furnished in any number on specific request from university presidents and deans for distribution among selected graduate and upper class undergraduate students.

ACTIVITIES OF DIVISIONS AND DIVISIONAL COMMITTEES

Division of Foreign Relations.—The council's division of foreign relations arranged for the appointment and attendance of official representatives of the council at meetings in the summer of 1922 of the International Research Council in Brussels, International Astronomical Union at Rome, International Geodetic and Geophysical Union at Rome, International Union of Pure and Applied Chemistry at Lyons, International Union of Scientific Radio Telegraphy in Brussels and International Geological Congress at Brussels. The council is a member of the International Research Council and all of its affiliated Unions, certain of the council's divisions acting as the American sections of these Unions. The council has recently adhered to the newly established International Union of Pure and Applied Physics. The annual dues to these international scientific organizations are paid by the government through the State Department under authority of a special appropriation item in the diplomatic and consular bill.

The council has taken energetic measures to aid the Australian National Research Council to have a strong delegation of American scientific men at the Second Pan-Pacific Scientific Congress which was held under its auspices in Melbourne and Sydney in August and September, 1923.

Dr. Robert A. Millikan, chairman of the division of foreign relations, has been appointed the American representative, succeeding Dr. George E. Hale, resigned, on the League of Nation's Committee on International Intellectual Cooperation.

The division's important committee on Pacific investigations has arranged with the Smithsonian Institution to have made a comprehensive study to be available for use in connection with the renewal and extension of the North Pacific Fur Seal Treaty which expires in 1926. This committee has also assisted in supporting a special expedition of the U. S. Bureau of Biological Survey to the Hawaiian Bird Islands. The Navy Department, the American Museum of Natural History and the Bishop Museum of Honolulu are also cooperating in this expedition.

Division of Federal Relations.—The council's division of federal relations has cooperated with the division of states relations in arranging to have made an important study on the cooperation of the federal government in scientific work with states, municipalities and individuals by Dr. E. W. Allen, chief, Office of Experiment Stations. This report which has been published (December, 1922) as No. 26 in the council's bulletin series discloses a total of more than five hundred separate projects in which the government is a partner with state and local agencies in cooperative scientific work. The funds involved in this cooperative work amount to at least fifty million dollars a year. This estimate does not include contribution in kind, such as land, office or laboratory quarters, special facilities, labor materials, etc., in many of the projects.

Division of States Relations.—The council's division of states relations has interested itself in having studies made by competent men of the present status of state activity in scientific research as assigned to and undertaken by the various state boards of agriculture and horticulture, geology and mining, game and fisheries, natural history, etc. Such studies have

been completed and published for California and Illinois, and other studies are planned for Massachusetts and Maryland.

The division has announced as special subject for its attention during the coming year the effect of the present tendency in the government of certain states toward the centralization of administration and particularly the effect of increased financial and commercial control in the progress of scientific matters established under state auspices.

Division of Educational Relations.—The council's division of educational relations, which has for special interest the relations of higher education and general educational methods to research and the training of research workers, has been engaged in making a survey of the research situation in the colleges and universities of the country. This work has been carried on by questionnaires, correspondence and most importantly and effectively by visits to the educational institutions by representatives of the council. Over 200 colleges and universities have been thus visited.

During the past year the division has given a special attention to the important matter of the methods in vogue—and the absence of such methods—in the colleges and universities of the country for the discovery, encouragement and special training of students of superior capacity from among whom alone the future research workers of the country are to be recruited. In connection with this study of "the problem of the gifted student" the division has had a series of special visits made to a total of about 100 institutions by men especially interested in and informed with regard to this problem, and has prepared and distributed to presidents, deans, professors and graduate and upper-class undergraduate students a series of reports and bulletins which have attracted much attention and been, apparently, gratefully received by the colleges and universities. Among these bulletins is the series of career bulletins for distribution to advanced students which are referred to elsewhere in this report under "Publications."

The division has been enabled to carry on its work of survey and stimulation by means of a special appropriation made by the General Education Board.

VERNON KELLOGG
Permanent Secretary

(*To be continued*)

COLLECTING PERIPATUS IN NEW ZEALAND

EVER since I have read anything about entomology and of the forms of life related to the Hexapoda, I have had a desire to see and to study under natural conditions Peripatus, one of the most primitive of the group to which the insects belong. Since this lowly arthropod does not occur in North America and is more or less circumscribed in its distribution, being confined largely to the South American, West Indian, African and Australasian regions, not many scientists in the United States have the privilege of observing the animal alive. Indeed, I feel sure that a considerable number of entomologists have never seen even a preserved one.

Therefore, it was with a good deal of satisfaction to myself that, as a participant in the South Sea expedition from the University of Iowa in the summer of 1922, I was able, in New Zealand, to do one of the things which I set out to accomplish, namely, to see and collect specimens of this unique and interesting animal as well as to bring back for our collections a goodly supply of examples. Incidentally, the privilege and opportunity thus offered represents one of the reasons for which such expeditions are organized at this institution.

The Dominion of New Zealand, comprising about 105,000 square miles, lies between 34° and 47° south latitude and 174° and 178° east longitude. Its topography is rough, and the soil, largely of volcanic origin, supports a fairly luxuriant and, in many ways, peculiar native vegetation. North Island, the scene of the hereindescribed activities, possesses a bright breezy climate, the mean annual temperature being about 55° Fahr. and the precipitation averaging a little more than 50 inches.

The native forests, many of which have been much depleted of late, consist largely of totari, tawa, remu, matai and beech; they are always green but the introduced trees all lose their leaves during the winter season (our summer).

About one and one half miles northwest of the city of Wellington and seven hundred feet above the sea there remains a remnant of one of these forests some fifty acres in area which is being maintained by the government as a reserve. In Wilton's Bush, as it is called, a considerable tract remains untouched by the forester's ax. Deep valleys, dense, hilly woods and a fine stream lend attractiveness and beauty to the place. The spiny bush lawyer (*Rubus* sp.) is plentiful and affords good beating for insects in the winter season. On the partly cleared hillsides the green, prickly gorse grows abundantly and, with its bright yellow flowers, adds a touch of color to the scene. Here, in the wooded portion of the bush within the damp and much decayed remu stumps and in the moldering down-timber of the cleared areas Peripatus abounds in some numbers.

In company with Mr. Harold Hamilton, of the Dominion Museum, a visit was made to this place on August 3 and again on August 7 for the purpose of securing specimens of this unique arthropod. Armed with sharp, heavy metal instruments the moist, de-

cayed wood of dozens of remu stumps and logs was exposed in the all-absorbing search.

Occasionally a specimen would be found under a log which rested well down in the earth but by far the largest proportion of the more than one hundred specimens taken was discovered in decayed wood. In the last log that I examined—a small one at that—six of these velvety-black, slug-like creatures were exposed. Specimens of both sexes and all sizes are included in the lot secured on the above dates.

Mention need not be made here of the structural characteristics of Peripatus since all this and much more has been so admirably done by Hutton, Moseley, Sedgwick and others. However, I should like to say a word concerning my own observations on its activities.

As is well known, Peripatus is nocturnal and shuns the light at all times. As soon as an individual is exposed it moves unerringly though slowly and deliberately toward some crevice or burrow or other hiding place. When irritated, as for example when it is picked up suddenly by the tweezers or squeezed lightly between the fingers, it ejects with some force and to a distance of from four to six inches the contents of the slime glands through the oral papillae. While the force is supplied largely by the sudden contraction of the muscular body wall, the direction and dispersal of the slime threads seems to be effected chiefly by the rapid side-to-side movements of the head and anterior part of the body.

After leaving the oral papillae the clear fluid hardens into a series of viscous strands bearing, at fairly regular intervals, minute droplets. Although harmless it is very sticky coming away easily from the animal itself but adhering tenaciously to other objects including one's fingers. I can not agree with Hutton's statement (*Ann. Mag. Nat. Hist.*, XVIII, 362, 1876) that "This viscid fluid is for offensive and not defensive purposes," for in my experience, it was certainly used in a defensive capacity. And I do not doubt that a spray of this fluid would, to say the least, prove very disconcerting to any enemy such as spiders or predaceous beetles, both of which live in the same situations as Peripatus. In 95 per cent. alcohol the slime collects in the form of a flocculent mass.

Specimens are most satisfactorily killed by immersing in water to which a little 95 per cent. alcohol has been added. They succumb, through suffocation, in a surprisingly short time—four or five minutes—and are best preserved in spirits of the above strength.

The now generally prevalent conviction regarding the affinities of Peripatus was well summed up by Hutton years ago (*l. c.*, 368) when he said in substance that it does not form a direct link between the other tracheate arthropods and the annelids, but is best regarded as an offshoot from the base of the arthropodan stem.

Dayton Stoner

The State University of Iowa

THE SECOND PAN-PACIFIC SCIENCE CONGRESS

The Pan-Pacific Science Congresses have been held on the initiative of the Pan-Pacific Union with headquarters at Honolulu, where the first of such gatherings met August 2–20, 1920. The second has been held August 13 to September 3 of the present year under the special auspices of the Australian National Research Council, with its president, Sir David Orme Masson, president of the congress. A considerable number of "assisted passages" were offered to distinguished scientists in over-seas Pacific countries, and to this inducement were added free railway transportation and housing while in Australia.

In all, between eighty and ninety over-seas delegates attended, the list including Col. Sir Gerald Lenox-Conyngham and Dr. Haddon among others from the British Isles; Drs. Brock, McMurrich and Fraser from Canada; Dr. Sakurai, and Professors Omori, Yamasaki and Oshima in a strong delegation from Japan; Drs. van Romburgh, van Leeuwen, Brouwer, Braak and others from the Netherlands. From New Zealand came Professors Kirk, Marshall, Speight and Benson and Mr. Morgan.

The delegation from the United States was exceptionally large—sixteen from the States, six from the Hawaiian and four from the Philippine Islands. The States delegation was as follows: In agriculture, Babcock, Mead and Stakman; in physics, Benfield, Moore and Wait; in geology, Brooks, Hobbs, Hovey and Vaughan; in geography, Fenneman and Huntington; in zoology, Pillsbry and Ritter; and in hygiene, Sayers. Professor Gregory, the president of the first congress, was in the Hawaiian delegation, and Merrill and Selga in that from the Philippines.

The program was one of exceptional interest to students of Pacific problems. In addition to a number of general sessions to hear important papers of general interest, there were special sections in: I, agriculture; II, anthropology; III, botany; IV, entomology; V, forestry, VI, geodesy and geophysics; VII, geography and oceanography; VIII, geology; IX, hygiene; X, veterinary science, and XI, zoology.

The geologists assembled in unusual strength both from Australia and from overseas, and their programs were contributed to by a considerable number of authorities in special fields. The topics included: The structure of the Pacific region; Post-Mesozoic volcanic activity within it; the distribution of ores, oil and water resources; the correlation of the Tertiary

formations; the Permo-Carboniferous and Permian problem, geological surveys, and a symposium on the origin of coral reefs and atolls. In connection with this symposium Professor Sir Edgeworth David, who presided at the Sydney sessions and who is widely and lovingly known as the grand man of Australia, presented a most important report on the Royal Society's borings at Funafuti. The half-cores from this boring and other illustrative exhibits were displayed.

A dramatic event of the meeting was the arrival at Sydney on the eve of the meeting in that city of the new United States scout cruiser "Milwaukee," equipped with the sonic depth finder and prepared to exhibit a new set of soundings taken on its voyage across the Pacific from Puget Sound. Her commander, Captain W. C. Asserson, came as a delegate to the congress from the United States Navy Department and presented a paper in joint session on the principle of construction and use of the depth finder. On his invitation the Australian Navy Department sent an officer from Melbourne to attend a demonstration, and on like invitation the Ministry of Trade and Customs sent for the same purpose Captain John K. Davis, the commissioner of navigation and widely known as the master of vessels of Antarctic explorers. Each day during the visit of the cruiser parties from the congress were taken on board for demonstrations. A hearty vote of thanks was taken to be presented to the United States Navy Department through Captain Asserson. The friendly visit to Sydney of this modern warship, the first since that of the great fleet under Admiral Sperry, aroused much popular enthusiasm and approval.

Many resolutions of importance were passed. These related to the destruction of insect pests; to measures to prevent the early extinction of the native Pacific races; for cooperation in botanical surveys; for systematic treatment of the tectonic features; for aeroplane and other surveys of coral reef areas, and especially that of the Great Barrier Reef of Australia; for an international bureau of animal health; and for the conservation of the marine mammals of the Pacific.

It was further recommended that there be formed a permanent organization of the scientific institutions and individuals engaged in research on the scientific problems of the Pacific region, and the president of the third congress was requested to take the initial steps for this organization.

Both during and after the congress excursions of great interest were participated in by large groups of delegates, the longest being those to the Broken Hill mining district and to the Great Barrier Reef of Australia, the latter in a government vessel for a period of three weeks at the conclusion of the sessions.

Upon cordial invitation submitted by the Japanese delegation it was decided to hold the third Pan-Pacific Science Congress in Japan in 1926. The invitation had already been accepted by the Council of the congress, but before coming before the general session for action news was received of the terrible devastation and general destruction of Tokyo and Yokohama wrought by earthquake and following seismic seawave. In this difficult situation the Japanese delegation decided to stand by its invitation, and the invitation was accepted with full understanding of the situation.

The hospitality of the Australians was most generous and cordial, and the over-seas delegates were warm in their praise of their hosts for their skilful management. As one who has attended many congresses of an international character, the undersigned feels warranted in saying that such generous hospitality has been seldom equaled. The sentiment found frequent expression that nothing could do so much to promote international good-will and so make for the maintenance of peace in the Pacific as meetings of this character. The United States Navy came in for much praise for the ways in which it has contributed to scientific research.

William Herbert Hobbs

Suoa

SCIENTIFIC EVENTS

DELONZA TATE WILSON

The death of Professor Delonza Tate Wilson, of the department of astronomy of Case School of Applied Science, Cleveland, Ohio, occurred on Friday, October 12, at the Kendall House Sanitarium, Washington, D. C., after a long illness.

A member of the faculty at Case for twenty years, Dr. Wilson did a great deal in building up the department of astronomy as well as in teaching mathematics. When the Warner and Swasey Observatory, dedicated in October 1920, was being planned, he assisted in the designing of the building and its equipment. He made a special study of ballistics and during the war conducted classes in that subject, cooperating with the Government Naval College and the Coast Artillery Division. The special astronomical research to which he gave his attention was the computation of tables of the perturbations of a group of asteroids, printed at Upsala in 1912.

Dr. Wilson was born in Clinton, N. C., soon after the close of the Civil War. He was graduated from the University of North Carolina in 1887, received his M. A. from Vanderbilt University in 1896, and his Ph.D. from the University of Chicago in 1905. He spent a number of years as a computer in the United States Observatory at Washington, then taught for two years, 1901–1903, at the University of Cincinnati,

before coming to Case in 1903 as an assistant professor. He was made associate professor in 1911. Illness compelled him to give up his work at the end of the college year in 1921.

A brother and a sister survive him; he was unmarried. Interment was at Clinton, N. C. Dr. Wilson was a very congenial, likable man, and a splendid teacher. He was a member of Beta Theta Pi.

KARL O. THOMPSON
Secretary of the Faculty

THE FOREST RESERVES OF THE STATE OF NEW YORK

REPEAL of the constitutional provision prohibiting the cutting of timber in the forest reserves of New York was advocated in a resolution passed by the executive board of the American Engineering Council of the Federated American Engineering Societies at its closing session in Rochester, N. Y., on October 13. The time has come, it was asserted, when a great volume of ripened timber should be cut both in the interest of conservation and of industry. This resolution, recommending that all the states pursue a modern forest policy, said:

> The State of New York owns something over a million acres of standing timber in the Adirondacks and Catskills. A provision in the State Constitution prohibits the cutting of this timber. Trees, like other field crops, ripen and decay, and not cut, become valueless and retard the growth of healthy young trees. The authorities are powerless to prevent this large loss in a densely populated section using forest products extensively and paying heavy transportation charges on far away cuttings. The profession of forestry is being rapidly developed and modern forest methods are well known in the United States. Trees can be cut, new plantings made, fire losses reduced, and the life and producing power of the forests continued almost indefinitely if timber tracts are intelligently treated. Further, they can be made self-supporting, and made to yield increasing revenue if rationally regarded, and this without impairing their esthetic or recreational value.
>
> The demand for forest products is increasing rapidly in the face of diminishing supplies, and costs are advancing.
>
> It, therefore, seems an opportune time for the people of New York State and other states possessing timber reserves to adopt a modern forest policy, which will permit the care of their forests on modern scientific lines. The Federated American Engineering Societies feel that the people of New York State will gain by removing the Constitutional restrictions on timber reserves, this question coming before the voters at a referendum on November 6, so that effective protective legislation can be passed.
>
> The state, it is believed, can safely put its forest problems in the keeping of trained foresters whose reputation depends on so maintaining the forests that they will become an increasingly valuable asset, rather than a serious burden, as they are to-day.

THE ALDRED LECTURES OF THE MASSACHUSETTS INSTITUTE OF TECHNOLOGY

THE first of the Aldred Lectures at the Massachusetts Institute of Technology, established by Mr. J. E. Aldred, who carried to a successful conclusion the immense hydro-electric development at Shawinigan Falls on the St. Maurice River in Canada, is announced for the afternoon of November 9. Mr. Gerard Swope, a technology graduate of the class of 1895, president of the General Electric Company, will deliver the first of the lectures. Other eminent industrialists and engineers are to complete the program for the first year which will consist of twelve lectures.

President Stratton has appointed Professor D. C. Jackson, head of the department of electrical engineering and Professor Vannevar Bush, in charge of graduate work in electrical engineering, to cooperate with Mr. Aldred in establishing the lectures. A number of prominent men have been invited to give papers in a schedule that is being arranged to cover the next five years. The lecturers, representing all branches of industry, come from all parts of this country, and some from Canada. The twelve lectures which will be given this year, will be open to the faculty, seniors and graduate students of the institute and to a limited number of outsiders, and will probably be published for general distribution next spring.

Mr. Aldred believes that "it will be a contribution to the engineer's training if the proposed lectures give the student an opportunity of coming in contact with men who have made an outstanding success in their various lines of undertaking, and who best illustrate the value of practical experience, coupled with technical knowledge. This contribution is put forward with the hope that it will assist the graduate student going out to take up his life's work by his having in mind at the outset of his career that the work he is to do must be a practical contribution to the problems of the day."

THE NEW ENGLAND INTERCOLLEGIATE GEOLOGICAL EXCURSION

THE nineteenth annual New England Intercollegiate Geological Excursion was held in the vicinty of Arlington and Beverly, Massachusetts, October 12 and 13, under the leadership of Professor Alfred C. Lane, of Tufts College; Professor Charles Palache, of Harvard University, and Mr. E. E. Fairbanks. The universities and colleges represented were as follows: Harvard (15), Massachusetts Institute of Technology (9), Tufts College (6), Brown University (4), Wes-

leyan (2), Colby (1), Massachusetts Agricultural College (1), Teachers School of Science (1), Union College (1), University of Witwatersrand, South Africa (1). Ten institutions were represented by forty-one persons.

On October 12 the group studied the gabbro-diorite series in the vicinity of Arlington and Medford. Pink granites and pegmatites were found cutting and permeating the diorites and the discussion centered about the age of these intrusions. Were they contemporaneous differentiates of the gabbro-diorite batholith or did they represent a later petrogenic cycle? On October 13 the rocks along the coast between West Manchester and Beverly were studied, and a number of the party visited Salem Neck. The complex of alkaline dikes (sölvsbergite, tinguaite, camptonite) attracted the most attention.

W. G. Foye,
Secretary

BOTANY AT CINCINNATI

Because of its general interest to botanists in their individual and organization plans for the Cincinnati meeting of the American Association for the Advancement of Science it seems desirable to announce in advance the program which has been arranged for the joint meeting of Section G with other botanical organizations. It has been planned that this program be given on the afternoon of the first full day of the session, Friday, December 27. In addition to the address of the retiring vice-president of Section G, Dr. F. E. Lloyd, who will speak on "The fluorescent colors of plants: their mode of occurrence and meaning," three invitation papers will be presented,—

The relation of environment to disease in plants: Dr. L. R. Jones.

Recent advances in cytology: Dr. L. W. Sharp.

Cell activity and H-ion concentration—some problems in metabolism and absorption: Dr. B. M. Duggar.

Robert B. Wylie
Secretary of Section G

SCIENTIFIC NOTES AND NEWS

Charles Proteus Steinmetz, consulting engineer of the General Electric Company and professor of electrophysics in Union College, died at his home at Schenectady on October 26, at the age of fifty-eight years.

According to a cablegram from Stockholm, the Nobel Prize for medicine for 1923 has been awarded to Dr. F. G. Banting and Dr. J. J. R. MacLeod, of Toronto, for their discovery of insulin.

At a special convocation on October 8, Syracuse University granted the honorary degree of Doctor of Science to distinguished delegates from foreign countries attending the World's Dairy Congress at Syracuse. Recipients of this honor were: Professor Orla-Jensen, of Denmark; Professor Haakon Isaachsen, of Norway; Dr. Robert Burri, of Switzerland; Gerald Leighton, M.D., of Scotland; Robert Stenhouse-Williams, M.D., D.P.H., of England; Sir Arnold Theiler, D.V.M., D.Sc., of South Africa; Charles Porcher, of France; Professor Masayoshi Sato, of Japan, and Charles Hastings, M.D., LL.D., of Canada. The degree of LL.D. was bestowed upon Professor Van Norman, dean of the University Farm School, University of California and president of the World's Dairy Congress, and upon Cesare Longobardi, LL.D., chief of the Statistical Bureau of the International Institute of Agriculture, Italy.

At the inauguration on October 18 of Dr. George Johnstone Trueman as president of Mount Allison University, Sackville, N. B., Canada, the degree of doctor of laws was conferred on Dean F. D. Adams, professor of geology, McGill University, and on Professor R. C. Archibald, professor of mathematics, Brown University.

The Academy of Medicine of Mexico, has elected as honorary members Dr. W. J. Mayo, of Rochester, Minn., and Dr. A. J. Ochsner, of Chicago.

The Chalmers gold medal for the best work on tropical medicine by investigators under the age of forty-five years has been awarded to Dr. Roubaud, general secretary of the Société de Pathologie exotique of Paris.

Dr. B. T. Baldwin has been elected president of the University of Iowa Research Club which consists of seventy head and research professors from the various colleges and departments in the state university.

Dr. R. B. Sosman, of the Geophysical Laboratory, Washington, D. C., has been appointed by the National Research Council as American member on the permanent committee for the standardization of physico-chemical symbols of the International Union of Pure and Applied Chemistry. The other members of the committee are: Professor Ernst Cohen, University of Utrecht, chairman; Professor Alexander Findlay, University of Aberdeen, and Professor Charles Marie, Sorbonne.

Sir Archibald Garrod, M.D., F.R.S., regius professor of medicine in the University of Oxford, has been appointed a member of the Medical Research Council in succession to Professor F. Gowland Hopkins, F.R.S., who retires by rotation. The appointment of Sir Archibald Garrod was made by the committee of the Privy Council for medical research,

after consultation with the Medical Research Council and with the president of the Royal Society.

Raymond B. Ladoo, M.E., has resigned his position at the Bureau of Mines, Washington, D. C., to become general manager of the Southern Minerals Corp., Cleveland, Tenn.

Dr. George H. Pethybridge, formerly mycologist of the Department of Agriculture and Technical Instruction for Ireland, has resigned to accept the position of mycologist for the Ministry of Agriculture and Fisheries of England. Dr. Pethybridge is working at the Pathological Laboratory, Milton Road, Harpenden, Herts, England. The position of mycologist for the Department of Agriculture in Dublin has been abolished. Dr. P. A. Murphy, formerly assistant to Dr. Pethybridge has been placed in charge of the research work in plant pathology while the other assistant, Mr. H. A. Lafferty, has been appointed head of the Irish Department Seed Testing Station.

Mr. Lawrence Ogilvie, graduate of Aberdeen University, who has recently completed his graduate work in science at Cambridge, has been appointed plant pathologist to the Bermuda Department of Agriculture. His address is Paget East, Bermuda.

It is reported from Vienna that Professor Sigmund Freud, founder of psychoanalysis, underwent, on October 21, a serious operation in a Vienna hospital. His condition is said to be favorable, but Dr. Freud is now more than seventy years of age.

Dr. E. Perroncito, professor of pathology at Turin, retires from his chair this year, having reached the age limit. He is to preside at the postponed international congress on comparative pathology that was to have convened in Italy this year.

The *Journal* of the American Medical Association reports that Dr. Clemens F. Pirquet, for two weeks head of the department of pediatrics at the University of Minnesota, has resigned and will return at once to Vienna, Austria. The principal reason for leaving given in a statement by Dr. Pirquet was that the research work in which he is engaged requires a large amount of clinical material and an organized hospital and that the comprehensive plans for a hosiptal provided by the Eustis bequest would require considerable time for completion. Dr. Pirquet also expressed a feeling of homesickness for his Vienna hospital and of inability to adapt himself to his new conditions; a third reason was the continued illness of Mrs. Pirquet since her arrival in the United States.

T. E. Swigart, superintendent of the Petroleum Experiment Station of the Bureau of Mines, at Bartlesville, Oklahoma, has been granted a furlough of some months to respond to a call to India by the Attock Oil Company, Ltd., to assist in solving operating troubles of the company's holdings. During Mr. Swigart's absence, M. J. Kirwan, petroleum engineer, will serve as acting superintendent of the Bartlesville Station.

Zai-ziang Zee, head of the department of chemistry of the College of Yale in China, is taking a course in chemistry this year in the Yale Graduate School with a view to securing his doctor's degree.

Dr. Colin G. Fink, of the division of electrochemistry of Columbia University, addressed the chemists of the Dow Chemical Company, Midland, Mich., on "Metallurgical Research" at their October meeting.

Professor William Snow Miller, of the department of anatomy, of the University of Wisconsin, repeated at the September session of the School of Tuberculosis held at the United States Veterans' Hospital at New Haven, Connecticut, the series of lectures given at the March session on "The anatomy of the lung and its relation to certain phases of tuberculosis."

Professor Hans Driesch, of the University of Leipzig, gave a lecture on "Mind and Body" in the medical amphitheater of Johns Hopkins Hospital on October 16.

An inaugural lecture on the present tendencies and future compass of physiological science was given by Professor A. H. Hill, F.R.S., at University College, London, on October 16. The chairman was Professor E. H. Starling, F.R.S., Foulerton professor of physiology, and Professor Hill's predecessor in the chair he now holds.

The centenary of the birth of Henri Fabre, the distinguished French naturalist, will be celebrated by the erection of a monument at Sérignan. A committee has been formed for this purpose under the patronage of the president of the French Republic. Subscriptions may be sent to M. Henry de la Pailloune, mayor of Sérignan (Van Cleuse).

Dr. Henry J. Barnes, professor of hygiene at the Tufts College Medical School for many years, has died in Northboro, Mass., at the age of seventy-five years.

Professor A. D. Pitcher, head of the department of mathematics in Adelbert College, Western Reserve University, died on October 5, at the age of forty-three years.

Professor Ernest Salkowski, director of the chemical laboratory of the Berlin Charité Hospital, known for his work on physiological chemistry, has died at the age of seventy-nine years.

JULES VIOL, professor of physics at the Conservatoire des Arts et Métiers, died on September 12, aged eighty-four years.

THE deaths are announced of Dr. P. Friedländer, professor of organic chemistry in the Technical School at Darmstadt, and of Alexander Ellinger, professor of pharmacology at Frankfort.

DR. W. V. BINGHAM, of Carnegie Institute of Technology, Pittsburgh, has been elected editor and Dr. L. L. Thurstone, of Washington, D. C., associate editor of the *Journal of Personnel Research*. Dr. C. S. Yoakum continues as managing editor of the Journal which is now entering on its second volume. The other members of the editorial board are Wesley C. Mitchell, Alice Hamilton, Frankwood E. Williams, R. W. Husband, Matthew Woll, Leonard Outhwaite, Joseph K. Willets, Lewis M. Terman, Alfred D. Flinn and Mary Van Kleeck. This journal is the official organ of the Personnel Research Federation whose purpose is the furtherance of research activities pertaining to personnel in industry, commerce, education and government.

THE American Fisheries Society held its fifty-third annual meeting in St. Louis, at the Hotel Statler, on the 17, 18 and 19 of September. President Glen C. Leach, of the Bureau of Fisheries, Washington, presided. There were eighteen papers presented by members of the society and a symposium on "Food and feeding of fish." Some of the best authorities on fish culture took part in this discussion. The officers for the coming year are: *President*, Dr. George C. Embody, Ithaca, New York; *Vice-president*, Eben W. Cobb, St. Paul, Minnesota; *Executive Secretary*, John W. Titcomb, Hartford, Connecticut; *Recording Secretary*, Floyd Young, Chicago, Illinois; *Treasurer*, T. E. B. Pope, Milwaukee, Wisconsin.

AT its 266th meeting, held on October 9, the Elisha Mitchell Scientific Society celebrated its fortieth anniversary. Dr. F. P. Venable, the first president of the society, and the only surviving member of its founders, reviewed the forty years of its history in a paper entitled *Historical Sketch of the Elisha Mitchell Scientific Society*. Dr. W. C. George presented a paper entitled *Some Peculiar Amoeboid Cells in Perophora*. Fifteen men were elected to active membership and sixty-four to associate membership.

PROFESSOR E. PERRONCITO, of Turin, president of the International Congress on Comparative Pathology, announces its further postponement until 1924. It had been finally scheduled to meet at Rome on October 7, but the committee on organization was unable to make full preparation for it.

THE fifth commission of the League of Nations has adopted a resolution presented by M. Jacques Bardoux (France) recommending the transformation of the secretaryship of the commission on intellectual cooperation into an international bureau for the collection and distribution of information of interest to universities.

A PERMANENT organization to be known as the National Bollweevil Control Association was created on October 26, marking the end of the bollweevil menace conference at New Orleans. The association will be perfected by an executive committee of twenty-two members, representing the varied interests of the cotton industry. Claude G. Rives, Jr., of New Orleans, president of the Louisiana Bankers' Association, chairman of the conference, named part of this committee, which will meet on November 17 in New Orleans, when the full personnel will have been named. Those already named on the committee include: from the Department of Agriculture, W. D. Hunter and B. R. Coad, who is in charge of the Federal bollweevil experimental station at Tallulah, La.; from the Association of Southern Agricultural Workers, W. E. Hinds, of the Alabama Polytechnic Institute, and D. C. Hull.

A MEETING of the International Eugenics Commission was held in Lund, September 1–3, 1923. The following members were present: Major Leonard Darwin, Doctors Jon Alfred Mjøen, H. H. Laughlin, George P. Frets, Herman Lundborg, W. Johannsen, S. Hansen, M. A. Van Herwerden and H. Nilsson-Ehle. A definite invitation to have the next International Congress of Eugenics meet in Prague was received from Professor Růžička. The exact date is undetermined. Dr. August Forel, of Switzerland, was added to the commission.

THE Birth Rate Congress held its final meeting at Marseilles on September 30 under the presidency of M. Paul Strauss, the minister of hygiene. Telegrams were addressed by the Congress to M. Millerand, president of the Republic, and M. Poincaré, urging them to support the reforms necessary to remedy the evil of depopulation. A letter from M. Maurice Barrès was read, in which amendments to the laws of inheritance, which were declared to be one source of depopulation, were asked for.

THE fifteenth session of the International Institute of Statistics was held at Brussels during the first week in October under the presidency of M. Delatour, of the Institute of France.

THE Michael Reese Hospital, Chicago, announces the establishment of two fellowships of $30,000 each and two research funds of $50,000 each; the first by Mr. and Mrs. John Hertz, the second by the trustees of the Joseph G. Snydacker estate, the third by the

trustees of the Gusta Morris Rothschild estate and the fourth by Albert Kuppenheimer.

Professor Brouwer, of Delft, Holland, has sent a set of invertebrate fossils of Permian age to the geological museum of the University of Michigan. Professor Brouwer, who was the exchange professor with Professor W. H. Hobbs of the department of geology last year, made the collection in the Dutch East Indies.

The legacy of one million francs left by the late Prince Albert of Monaco to the French Academy of Medicine, is to be used to found a prize for doctors for certain kinds of medical service or discoveries. It is intended that the value of the prize shall be 120,000 francs and that it shall be awarded once every two years. The council of the academy has not yet decided whether the prize is to be international.

A society of Bologna has founded an endowment of 6,000 francs yearly for an Italian student of physics and chemistry who wishes to do research work in the Curie Laboratory, Paris. The fellowship is endowed for ten years.

A party from the public health service in Mexico has been visiting the Institute for Tropical Medicine at Hamburg, to aid in establishing closer relations between the institute and the state of Mexico.

The British Department of Scientific and Industrial Research announces that a license has been issued by the Board of Trade to the Research Association of British Flour Millers under the conditions laid down in the Government scheme for the encouragement of industrial research.

According to figures of the United States Forest Service compiled for the fiscal year ended June 30, revenues from sales of timber and livestock grazing permits and use of forest lands for summer homes and hotels brought in $5,335,818. This amount is about $1,000,000 larger than the average annual receipts of the preceding five years. Of the receipts, $1,371,551 will be paid over to states containing national forests for use as school and road funds of the counties in which the national forests are located. An additional $528,569 will be used in building roads and trails in the forests. Twenty-seven states and Alaska shared in the distribution, California receiving $445,675.

The London School of Tropical Medicine has arranged to send an expedition to Samoa to study the prevention of elephantiasis and filariasis, diseases which affect 85 per cent. of the inhabitants of the Samoan group. The expedition will have its headquarters at Apia and will be away for two years; it will work in cooperation with the New Zealand government, which is responsible for the administration of Samoa. The expedition, which will leave England on November 15, will be under the leadership of Dr. Patrick Buxton, who did valuable work on entomology in Mesopotamia during the war, and has recently been entomologist to the Palestine Government at Jerusalem.

UNIVERSITY AND EDUCATIONAL NOTES

Mr. Edward and Miss Ada Doernbecher, of Portland, Oregon, have recently donated $200,000 to the University of Oregon Medical School to be used in the construction of the Doernbecher Memorial Children's Hospital on the campus of the medical school.

Charles Stillman, of New York City, has given to Yale University the sum of $100,000 to establish the James Raymond Goodrich Scholarship Fund to provide each year ten scholarships of $500 each, to be awarded to students of exceptional character and ability.

Formal dedication of the new pathological laboratory building of the Johns Hopkins Medical School was held on November 1. Addresses were made by Dr. Frank J. Goodnow, president of the university; Dr. William G. MacCallum, Baxley professor of pathology, and Dr. William H. Welch, director of the Johns Hopkins School of Hygiene and Public Health.

Frank Dickson, for the past three years instructor in plant pathology in Cornell University, has been appointed assistant professor in plant pathology in the University of British Columbia, Vancouver, B. C.

Dr. M. A. Chrysler has resigned his position as head of the department of biology of the University of Maine to accept a position in the department of botany of Rutgers College.

Dr. W. A. Whitesell, of the Johns Hopkins University, has accepted a position as associate professor of chemistry at the University of South Carolina.

Dr. Franklin C. McLean, for several years director of the Peking (China) Union Medical College, has been appointed professor of medicine at the University of Chicago Medical School.

DISCUSSION AND CORRESPONDENCE

THE FIRE IN CALIFORNIA

It appears that the accounts of the great conflagration of September seventeenth in Berkeley, which appeared in the public press in various parts of the world, were inaccurate in various degrees, and it seems advisable that a correct statement of the salient facts be published.

A grass, brush and forest fire in the hills northeasterly from Berkeley, fanned by an extremely strong northeast wind, got beyond control and between the hours of 2:45 p. m., and 5:15 p. m., spread over

an area of about sixty "blocks" immediately adjoining the University campus on the north. The spread of the fire was very rapid; in many cases ten minutes sufficed to carry the flames from one street to the next parallel street. In most cases the occupants of the residences did not have time to remove their possessions to appreciable extent. In the burned area lived about 60 University professors, associate professors and assistant professors, and about 50 instructors, assistants and associates; about 30 secretaries, library assistants, clerks and stenographers in the employ of the University; and 1,042 University students. The number of fraternity and sorority houses consumed was about 12.

Not only did members of the University community suffer serious loss and inconvenience as to residences and furnishings, but the libraries of those who were burned out, and other collections intimately related to their university duties, were consumed. In a few cases professors' manuscripts embodying the results of several years of research were lost. The students who were burned out did not devote their efforts in general to saving their own equipment of clothing and books, but unselfishly joined with the informal organizations of students engaged in getting the occupants of houses into safety zones, in removing limited quantities of residence contents to the University campus and elsewhere, and to efforts looking toward the staying of the flames.

Relief measures were promptly organized, and assistance has been rendered, though on a relatively small scale, to those in most serious need. Many organizations in Berkeley and in the San Francisco Bay region, operating chiefly through the Berkeley Chapter of the American Red Cross, have gone far to meet these needs. The unofficial relief centers and countless individuals have given assistance more directly upon a commendable scale. The spirit of those who suffered has been admirable, so far as I am aware in absolutely every case. All concerned have been averse to the making of a public appeal for help. Both the Red Cross and the University Committee engaged in meeting the situation have found their chief difficulty, not in the securing of relief funds, but in obtaining from those who suffered loss the information necessary to the carrying out of adequate and wise relief policies.

No University buildings were consumed or seriously damaged, and the University's minor losses are summed up in a few thousands of dollars. More than half of the students affected lost their lecture notebooks, and in other ways their studies were interfered with for a few days. Many of the professors who were burned out on Monday afternoon, September seventeenth, were in their lecture rooms early Tuesday morning; and the same spirit of determination to carry on has not diminished in the intervening three weeks.

Messages of sympathy for those members of the University community who suffered have been numerous, and have come from great distances—from the University of Louvain on the one hand and from the University of Peking on the other. In behalf of the University of California I desire to thank the senders of the messages and all those whom the messages represented. As an instance of sympathy and assistance extended, I desire to speak especially of the benefit concert given in the Greek Theater of the University by the San Francisco Symphony Orchestra under the leadership of Mr. Alfred Hertz. The services of the orchestra and of all who helped on that occasion were provided gratis by those who rendered them.

W. W. Campbell

University of California

APPLES, WORMS, PHILOSOPHERS AND GOATS

Charles Darwin once showed the intimate connection existing in nature between cats, mice, bumble bees and clover. The classical presentation of this great naturalist must be at once my inspiration and excuse for offering some further biological reflections on the relationships of apples, worms, philosophers and goats. It will be necessary, in this ecological excursion, to go somewhat farther back than Darwin did, and begin at the beginning, in the same manner as the book of Genesis. We may have to invoke some form of metempsychosis or paronomasia, but in these days of advanced psychical research this should offer no difficulty.

It is necessary, in the first place, to show that the apple into which Adam sank his teeth was wormy, and, in the second place, that he nipped the worm's tail in this his maiden effort at consuming a specimen of *Pyrus malus*. It may be objected that, in the Garden of Eden, in which everything was perfect, there were no worms in the apples. I think that this objection may be easily overthrown, and I take as an authority no less a person than Mr. William Jennings Bryan. It is definitely known, according to Mr. Bryan, that the Lord created all plants and all other animals before he created man. Apple worms must, therefore, have been created before man. Since all transmutation of species by evolution must be excluded, these worms must have had to eat something to keep them alive, and they must have eaten apples and nothing else. In the perfect balance of things that must have obtained in the Garden of Eden, there was an apple for every worm, and, we may say also, a worm for every apple. By the use of pure Aristotelian logic, we have arrived at the conclusion that the apple which Adam ate was wormy. If any one

doubt this, I can only quote Oliver Wendell Holmes's old dictum that "Logic is logic."

We have now to show that Adam nipped the worm's tail when he bit into the apple. This is a relatively simple process, involving only a slight basis of observation of animal behavior and a little pure logic. Before Adam ate the apple, he was simple-minded, even as the rabbits and squirrels which played in the Garden, and could not have known about the habits of apple worms. Any one who has watched a horse or a cow or a pig or a baby or any other frugivorous animal eat an apple will readily appreciate the peril of the worm. Bearing in mind Adam's social training and table manners in his state of pure innocence, I need not labor the argument further to show that he nipped the worm's tail. Again, logic is logic.

Thirdly, we may point out that the worm, suffering mayhem in the first degree, was not long unavenged. Before this, it was incumbent upon him to dodge preying teeth and make his escape from danger. But with the acquisition of wisdom on Adam's part, he learned to know which apples were wormy and which were not, since the perfect balance in the Garden was now upset and he was driven out of it, and the responsibility now shifted from the worm to man. Whereas, in the Garden it was "Caveat vermis," we now say "Caveat emptor" and other things of this kind. All this has worked for the peace of mind of the worm, but for man, the case is different. It might be a more tranquil world if the worm still had to worry. Spraying apple trees is only a belated and partially effectual attempt to shift the responsibility back to the worm. But neither this nor the proverbial early bird relieves the boarding house guest from all responsibility with regard to prunes. The worm still has the better of the argument.

The general proposition of the recognition of worms of whatever sort in apples of whatever kind requires considerable philosophical insight, and there have been men in the world ever since the time of Adam, or soon after, who have had this facility in systematic zoology. They have not all been entomologists, for apple worms are not really worms, you know, but all of them have been philosophers, each after his own system. Among the other evils which Adam's gastronomic indiscretion brought into the world must be reckoned the philosophers, for their persistent exposure of human sham—really nothing more than a euphemism for worms in apples—has contributed much to the discomfort of many estimable people. All this must be reckoned as evil. The philosopher is so constituted that worms in apples disturb him, while those happier beings of more bovine intelligence, if they were capable of getting the philosopher's point of view, might think him foolish to worry about worms at all. And it is in connection with worms in apples that the philosopher's metempsychosis occurs. Having once recognized the worms in the apples, and having pointed them out, he is quite likely to find that the responsibility in the matter has shifted from the worm to him. In other words, he has become the goat, and the worm has no further cause for worry.

Philosophers have been associated in the popular mind with the academia since the days of Plato, although Diogenes contented himself with a lantern and a tub, preferring the security of these to the uncertainties of academic tenure. It is doubtful whether the density of philosophers per million of population is any greater in the academia than it is in the general public at large, but they seem to be more prominent in the academia, and their prominence comes from their facility in detecting worms in the apples. Partaking of the double nature of philosopher and goat, the philosopher is particularly likely to become obnoxious in such an environment. He may innocently nibble at a gorgeous verbal bouquet intended for some strenuous defender of the system, because, to him, it bears a striking resemblance to spinach or some other herbage of this sort, and thereby incur the wrath of the powers that be. Or he may nip off the blossoms of a spray of lilies of the valley intended for some colleague, and expose the hemlock that has been concealed in it. This is a reprehensible trait, and the offence is generally punished as it deserves to be.

The worm is said to turn, and to manifest other evidences of an evil temper at times, particularly when trodden upon. But the most important characteristic of the goat which has been recorded in Holy Writ is that he shall have the sins of the tribe hung upon him and be driven out. This speaks well for the goat's gentleness of temper and general simple-mindedness, despite his facility as a philosopher in recognizing worms. If the artist's conception of the matter is correct, the painting by Holman Hunt shows a resemblance of the goat's decorations just before he is to be driven out to the academic robes and gayly colored hood of the philosopher in the academic procession. Somewhere it is stated also that the rocks are a refuge for goats.

The Greek attitude towards goats was more kindly, perhaps because of the lenient attitude of the Greeks towards philosophers. And I believe that it was a Greek who noticed that goats dance in the sun. But even in Greece, neither goats nor philosophers wholly escaped being offered up as a sacrifice. And if my conception of a philosopher-goat seem a fanciful one, one has only to recall the great god Pan.

At one time a distinction was drawn between academia and schola—between the institution for thought and that for mere pedagogy—but perhaps it would be invidious to insist upon this distinction at the present day. The term school is so common in

connection with our professional institutions, and generally so accurately descriptive, that no other term seems necessary. Furthermore, many so-called academies fall so far short of Plato's model that the words college and university seem all that are required to-day. Few philosophers will disagree with President Lowell's statement that America has failed to contribute its share to the world's thought.

But no one of these institutions should be without at least one philosopher apiece, for of such is the family of goats.

F. H. Pike

Columbia University

PACHYOSTOSIS

The term *Pachyostosis* to denote a benign type of osteohypertrophy, especially in aquatic animals, was first clearly discussed by O. Abel in his "Paleobiologie." It is interesting to note the animated discussion of the possible phylogenetic significance of this condition at the meeting of the German Paleontological Society at Tübingen in August of last year. The subject arose following the reading of Nopsca's paper[1] on the osteology of a Cretaceous snake. Baron Nopsca proposes the unusual term *Arrostie* for the condition of Pachyostosis, but spoils it by including in his classification such diverse pathological conditions as Osteosclerosis, Acromegaly and later some one proposed to include in it the condition known as Osteoporosis. This conception seems to me to be quite wrong, and I wish to add this word to the discussion.

It seems to me that the new term Arrostie is unnecessary and misleading. It implies a combination of conditions which does not exist. Pachyostosis, as I understand it, does not involve either infections or other pathological results, but is to be regarded as an adaptation in vertebrates to an aquatic habitat. The hypertrophy is a condition largely of the ribs and vertebrae, and while it may sometimes be due to the presence of heavy dorsal armor, yet more frequently it seems to me the thickening of the bones is an adaptation, permitting the animal to submerge more readily and to remain under the surface. Osteosclerosis is not an accompaniment of the pachyostosis in the few histological examinations of pachyostotic bones I have made. The unorganized deposition of calcium salts in callus following fracture, and in areas of intensely rapid growth stimulated by infection constitute a condition of osteosclerosis far removed from any interpretation of pachyostosis. I have recently noted in a Pleistocene tiger a condition in the pelvis resembling in its great and uniform hypertrophy of both rami the heaviness seen in Pachyostosis. This was due, clearly, to the intense infection the results of which are evident in the sacrum, where the most posterior sacral element is greatly exaggerated in size.

It would seem unwise to include under the same classification such diverse hypertrophies as acromegaly, osteosclerosis and the absorptive process of osteoporosis. In fact, osteoporosis accompanies a number of pathological conditions, though the term has been somewhat restricted in Paleopathology to a condition described in the human skull in which the hypertrophy is accompanied by a riddling of the inner skull table. Pachyostosis is also to be distinguished from many types of osteitis deformans, such as Paget's disease, Leontiasis and other hypertrophies which are due either to infections, disturbances in the endocrine organs, faulty nutrition or other causes.

It is even to be doubted if the thickening of the bones in aquatic animals is to be properly regarded as a phase of pathology in any sense, unless we give the widest latitude to our definition of disease. I should like to suggest, therefore, that we differentiate carefully between results of adaptation and pathological results. Pachyostosis is a benign form of hypertrophy and has no relation, in my opinion, to other hypertrophies of a pathological nature.

Roy L. Moodie

Venice, California

[1] F. Baron Nopsca: "Ueber eine neue Kreideschlange aus Dalmatien." *Paleontologische Zeitschrift*, Bd. V, Heft 3, p. 258. 1923.

QUOTATIONS

CONTRACT MEDICAL PRACTICE IN ENGLAND

The minister of health has answered the doctors in terms of arithmetic. He conceives that, in the final issue, an actuarial basis is that on which the capitation fee for panel practice, in company with all salaries and wages, must rest. In this view he has, without doubt, the full support of the friendly societies, whose members constitute the working population of the country. These societies, in their attitude to the medical profession, have discovered themselves as economists of the old school. A man's value, they suggest, is the amount which his services can conmand in the open market. This doctrine, when applied to the members of the friendly societies themselves, has not, it must be allowed, always worn, in their eyes, the aspect of reasonableness which it possesses when applied to doctors. Indeed it has frequently been assailed with bitterness as the creed of a rapacious *bourgeoisie* eager to exploit the helplessness of "wage slaves." Unhappily, it is impossible to have it both ways: what is "sauce" for the doctors must be "sauce"

also for their twelve million patients. The friendly societies, in short, have appealed to a law of economics which is certain to be invoked against many of their members in days to come.

The doctors, we understand, are to be advised by their leaders to refuse the terms offered to them, though there is, of course, no question of a "strike," as that term is understood by many of their patients. In other words, they may contest the view of the minister of health and the friendly societies that their value has been correctly assessed. Their right to enter on such a struggle will scarcely be disputed. They have declared that a willing and efficient service can not be given for a smaller sum than 9s. 6d. per head per year, and no one in his senses desires an unwilling doctor who is professedly incapable of doing justice to the case. On the other hand, it may be that the doctors' arithmetic is less sound than that of Sir William Joynson-Hicks and the friendly societies. This is the real question for the public. The minister of health has made a clear and very detailed statement; it is for the profession of medicine to answer him. If he has erred, if his arguments are not sound, and if, consequently, the capitation fee proposed is not adequate to its purpose, public support will assuredly be with the doctors. If, on the contrary, the case for reduction is a good one, the doctors will begin their battle at a disadvantage.

It is, however, possible that the doctors may decide to have done with the panel system altogether on other than financial grounds. It is admittedly rather late in the day to make such a change, yet there are and always have been weighty objections to the present system of contract practice. If it is to degenerate, as seems now to be possible, into the control of a learned profession by a group of benefit societies, the objections to it will be enormously enhanced. A doctor can not lose his freedom of action in relation to his patients and at the same time retain his self-respect. He may not suffer dictation in the conduct of his practice; if his patients object to his methods they possess their own remedy. It is, of course, possible that, if resignations from the panel occur, the vacant places may be filled. But we believe that this contingency should not be suffered to bias the minds of those physicians who, whether rightly or wrongly, regard the present situation as intolerable. The public will always hold in sincere regard those men who make sacrifice for the public welfare. The decision which the doctors must now take is one of the most important in the history of their profession in this country. Let them balance all the issues and, putting personal motives aside, act as the good servants of their fellows, which, in past years, they have in the vast majority of instances proved themselves.—London *Times*.

SPECIAL ARTICLES

ON THE INFLUENCE OF A ROTATING MAGNETIC FIELD UPON GROWTH

Whether magnetism has any effect upon biological activities has long been a source of speculation and experimentation. The types of magnetic fields used so far for investigation have been the constant unidirectional field and the alternating field; and the result of these studies has been that the unidirectional field has no physiological effect, while the alternating field if sufficiently powerful seems to have produced visual sensations.[1]

Because of the newer ideas regarding the constitution of matter, especially with reference to the work of Thomson and of Bohr on the character of the atom, it was decided to apply the magnetic field in a different manner than heretofore. From the premise of Bohr the electrons composing the atom are in a state of stable dynamic equilibrium except during light emission and absorption; and since the electronic orbits are subject to the influence of a magnetic field it was believed that a constant, uniformly rotating magnetic field, rather than a unidirectional or alternating magnetic field, would alter the dynamic equilibrium of the atom by affecting the configuration of the electrons. Based on this hypothesis the possibility existed of changing the character of the atom, thus secondarily affecting the molecule, and thereby causing changes which could possibly be observed in the study of growth.

A constant, uniformly rotating magnetic field was obtained by a three-phase winding upon a uniform iron coil displaced in the usual manner. The coil was operated upon the service of the local power company at a frequency of 62.5 cycles per second. The strength of the field, 1,410 gausses maximum, was measured by a small exploring coil in conjunction with an electrostatic voltmeter. The inside diameter of the coil was 14.25 cm. Care was taken that the field within the coil was not distorted by the presence of iron.

The first observations were made on the rainbow trout (*Salmo irideus*). In the center of the coil eighty eggs of this species were placed in a glass vessel on a single layer of gauze through a constant stream of water passed continuously from below. A similar vessel containing the same number of eggs and situated two feet from the coil was used as a control. But since this receptacle was separated from the coil by a piece of sheet-iron one eighth of an inch thick, the magnetic field in the control area was reduced virtually to zero. The magnetic field was applied con-

[1] Drinker, C. K. and Thomson, R. M., "Does the magnetic field constitute an industrial hazard"? *Jour. Indust. Hygiene*, 1921, III, 117.

tinuously for forty-five consecutive days and at the end of this time all the eggs had hatched. However, no difference either in the time of hatching, or in the general appearance and activity was observed between the fish hatched in the magnet and those in the control.

Observations were also made under the same conditions on eggs of the species *Amblystoma punctatum* which were placed in vessels similar to those used for the rainbow trout: in order to guard against any stray currents, the receptacle containing the control specimens was placed in an iron box in an adjoining room. Under these circumstances the magnetic field was applied continuously for twenty-six consecutive days, and again no difference between the specimens in the magnetic field and those in control vessel was observed.

Further experiments were carried on with rapidly multiplying organisms. Strains of a small bacillus, *B. coli communior,* as well as of a large bacillus, *B. megatherium,* were placed within a small incubator in the center of the coil. Control specimens, at the same temperature, were placed in the thermostat. Culture and staining of the bacteria were done in a uniform manner; but here also no difference in growth or morphology was observed.

These results are in accord with the conclusions of previous experimenters. All these investigations seem to infer that in the case of growth, matter is composed of atoms of which the electrons are in a state of static equilibrium. This evidence supports Thompson's conception of the nature of the atom as conceived for the solid or liquid state. On the other hand, had any changes been observed due to the influence of the magnetic field, growth would then follow more as a gaseous phenomenon, and involve the consideration of Bohr's concept of the atom. One would not be justified in concluding that growth involves only matter in the solid or liquid state; but as gases are involved also in the process of growth, it would seem that they either suffer a change in their atomic configuration and reach a state of static equilibrium, or that they are not assimilated in a state of stable dynamic equilibrium by the organism.

Frederick W. Lee
Ferdinand C. Lee

Department of Anatomy,
The Johns Hopkins University

THE LOS ANGELES MEETING

II

WESTERN SOCIETY OF SOIL MANAGEMENT AND PLANT NUTRITION

The Western Society of Soil Management held its second annual meeting in Los Angeles on September 20 and 21, immediately following the meeting of the Pacific Division of the American Association for the Advancement of Science. The papers were grouped into four sections, each occupying a half-day's session, according to the following program:

Thursday Morning, September 20

The Soil Solution

The nature and promise of the soil solution: John S. Burd.

The relation between the soil solution and the water extract of alkali soils: P. L. Hibbard.

Secular changes in the soil solution: John S. Burd.

The autotaxic curve as a means of studying soil colloids: A. E. Vinson.

Can we predict the crop producing power of soils from chemical analyses? W. F. Gericke.

Thursday Afternoon, September 20

Symposium on Alkali

Replaceable bases in relation to alkali soils: W. P. Kelley.

The rôle of calcium carbonate in soil alkalinity: A. B. Cummins.

The relation of certain alkali salts to the growth of plants: A. R. Davis and D. R. Hoagland.

The alkali tolerance of plants considered as a phenomenon of adaptation: J. F. Breazeale.

The effects of sodium chloride on young orange trees and their recovery: H. S. Reed and A. R. C. Haas.

Thursday Evening, September 20

Paulais Hotel.

Business meeting and banquet.

Friday Morning, September 21

Symposium on Soil Moisture

Comparison of established laws in hydraulics to recent investigations concerning the movement of soil moisture: O. W. Israelson.

The variability in the composition of the ground water of alkali soils: E. E. Thomas.

Soil moisture conditions above a ground water table and its relation to alkali: W. W. McLaughlin.

The movement of soil moisture: T. J. Veihmeyer.

Friday Afternoon, September 21

The Use of Sulfur in Agriculture

The supply of sulfur in soils: D. S. Jennings.

Further studies of the gains and losses of soil sulfur: J. S. Jones.

Field experiments with sulfur as a fertilizer: W. L. Powers.

The present status of the problem regarding the utilization of sulfur as a treatment for alkali soils: C. D. Samuels.

The effect of sulfur on soils: J. L. St. John.

Saturday, September 22

Visit to the Citrus Experiment Station, Riverside, California.

The society was organized at Salt Lake City in June, 1922, as the result of an "Alkali Conference" held with the Pacific Division. It was soon realized from the diversity of papers offered and interest shown that although alkali was the central theme, its

consideration involved the three-fold relation: the plant, the soil, and the soil moisture. Hence the broader scope of the society as indicated by its name. The purpose of the society is to facilitate an exchange of ideas and to promote good fellowship among the numerous soil scientists of the Pacific and Rocky Mountain States, without engaging in publication.

At the Los Angeles meeting it was decided to affiliate with the Pacific Division, but to hold program sessions of the society either immediately before or after those of the Pacific Division. The officers for the first year were: W. P. Kelley, *President,* Citrus Experiment Station, Riverside, California; O. W. Israelson, *Vice-president,* Utah Agricultural College, Logan, Utah; Robert Stewart, *Secretary-Treasurer,* University of Nevada, Reno, Nevada. The officers for the ensuing year are: A. E.. Vinson, *President,* University of Arizona, Tucson, Arizona; W. L. Powers, *Vice-president,* Oregon Agricultural College, Corvallis, Oregon; D. S. Jennings, *Secretary-Treasurer,* Utah Agricultural College, Logan, Utah.

A. E. VINSON

PACIFIC DIVISION OF THE PLANT PHYSIOLOGICAL SECTION OF THE BOTANICAL SOCIETY OF AMERICA

THE Pacific Division of the Plant Physiological Section of the Botanical Society of America held its second annual meeting at Los Angeles in conjunction with the other affiliated societies of the Pacific Division of the American Association for the Advancement of Science, September 17–20. Two sessions were held on Tuesday at which papers of general physiological interest were presented and discussed. Wednesday forenoon was given over to a symposium on "Growth and Permeability" with discussion lead by Dr. D. T. MacDougal, Desert Botanical Laboratory; Dr. H. S. Reed, Citrus Experiment Station, and Drs. A. R. Davis and D. R. Hoagland, University of California. On Wednesday afternoon the Plant Physiological Section met with the plant pathologists, economic entomologists and ecologists in a symposium on "Ecological factors influencing the distribution and severity of insect pests and plant diseases." Dr. E. T. Bartholomew, of the Citrus Experiment Station, lead the discussion for the plant physiologists.

The attendance at the meetings was good and the discussions indicated a marked degree of interest in the papers presented. Judging by the interest in the meetings for the two years that this new section of the Pacific Division of the American Association for the Advancement of Science has been in existence, it has an interesting and profitable future before it.

The officers for the coming year are Dr. Geo. B. Rigg, University of Washington, *President,* and Dr. F. E. Denney, U. S. D. A., 142 So. Anderson St., Los Angeles, *Secretary.* It was left for the executive committee to choose the vice-president after it had been determined where the meetings were to be held next year.

GEORGE B. RIGG,
Secretary

THE PACIFIC COAST ENTOMOLOGICAL SOCIETY

THE ninety-first meeting of the society was held at the University of Southern California, Los Angeles, on September 11.

Upon motion of Dr. E. P. Van Duzee, seconded by R. E. Campbell, Dr. J. A. Comstock was elected chairman for the meeting and H. E. Burke, secretary.

The following members and guests were present: A. J. Basinger, H. E. Burke, R. E. Campbell, J. A. Comstock, F. R. Cole, H. S. Fawcett, C. K. Fisher, R. D. Hartman, Trevor Kincaid, A. O. Larson, Isabel McCracken, H. S. Smith, H. E. Summers, E. P. Van Duzee, Mr. and Mrs. W. H. Volck, Mr. and Mrs. W. S. Wright, Mr. Osterhout.

Problems of the amateur entomologist: W. S. WRIGHT. Discussion by Comstock, Van Duzee and Wright.

Entomology at the California Academy of Sciences: MR. E. P. VAN DUZEE. Discussion by Comstock, Wright and Van Duzee.

Curious diptera from the Philippines and adjacent regions: MR. F. R. COLE.

The alder sawfly. The European earwig: MR. TREVOR KINCAID.

The rediscovery of a lost species: MR. J. A. COMSTOCK. Discussion by Wright, Comstock and Van Duzee.

After an informal discussion the meeting adjourned.

H. E. BURKE,
Secretary pro tem.

PACIFIC SLOPE BRANCH AMERICAN ASSOCIATION OF ECONOMIC ENTOMOLOGISTS

THE members of the Pacific Slope Branch of the American Association of Economic Entomologists assembled on September 17 and proceeded with the election of new officers as follows:

Chairman	H. S. Smith
Vice-chairman	C. M. Packard
Secretary-treasurer	R. E. Campbell

Members of the Affiliation Committee are W. B. Herms, chairman, and E. P. Van Duzee.

A very satisfactory attendance was recorded and

the meeting was one of especial interest, although a number of the members were compelled to return to their homes in Berkeley because of the fire. The representation of the western district was not at all satisfactory inasmuch as the attendance was almost entirely from California. Many of the western states have not sent a representative to the meetings for several years, and it is hoped that they will realize the importance of attending the meetings in order to make the Pacific Slope Branch really worthwhile.

The program was largely in the form of a symposium discussing chiefly dusting, biological control and the relations of insect pests in the distribution of plant diseases.

E. O. Essig,
Secretary

PACIFIC FISHERIES SOCIETY

The meeting of the Pacific Fisheries Association was called to order by President Cobb on September 18. Inasmuch as the minutes of the last meeting were not available these could not be read. President Cobb appointed the following committees:

I. *Nominations Committee:* Mr. W. B. Scofield, Professor Kincaid, Professor Fasten and Professor Starks.

II. *Auditing Committee:* Professor E. V. Smith and Professor Kincaid.

III. *Resolutions Committee:* Mr. Seale, Mr. W. L. Scofield, Mr. Thompson and Mr. Bowder.

IV. *Committee for Place of Next Meeting:* Mr. Crandall, Mr. Seale and Professor Kincaid.

The report of the treasurer was read and accepted. Applicants for new membership were considered, voted upon, and elected. Mr. Bowder reported arrangements for a trip around the harbor of Los Angeles for Thursday morning. The program of the afternoon consisted of a paper by Mr. Thompson, entitled, "What the State of California is doing to conserve the food fishes of Southern California." A discussion followed the presentation of the paper. At 4 p. m. the meeting adjourned to meet with the Western Society of Naturalists in order to view pictures of the birds of Laysan Island and also of the Tuna fisheries in California.

The second session of the organization was held the following morning, September 19, when the Nominations Committee reported the following officers for the ensuing year 1923–1924:

President, Dennis Winn, Seattle, Washington.

First vice-president, Will Thompson, California.

Second vice-president, C. McLean Fraser, Vancouver, B. C.

Secretary, Clarence Anderson, Seattle, Washington.

Treasurer, Clarence Anderson, Seattle, Washington.

Executive Committee, John N. Cobb, Seattle; N. B. Scofield, San Francisco; E. A. Seaborg, Seattle; J. W. Kinney, Seattle; Barton Warren Evermann, San Francisco; Alvin Seale, San Francisco.

Mr. Seale, of the Resolutions Committee, presented the following resolutions which were unanimously supported by the organization:

I.

Whereas, The building of dams in streams in connection with irrigation and power projects is proving a serious menace to our runs of anadromous fishes, especially when there have been installed unsuitable fishways or none at all.

Therefore, be it resolved, That the Pacific Fisheries Society in convention assembled at Los Angeles, California, September 17–20, 1923, requests the U. S. Reclamation Commission, and such other public officials as may have jurisdiction in such matters, to require that the problem of assisting anadromous and other fishes in getting over such obstructions, and the young in working their way back to their natural habitat in the sea, be taken up and considered along with the engineering and other problems relating to each project; and this Society promises every aid possible in solving the biological phases of the problems.

II.

Whereas, It is a known fact that the salmon fisheries of Alaska are not producing as formerly, the decline being due partly to lack of adequate regulation and partly to other causes; and

Whereas, The Department of Commerce has been attempting to meet existing conditions by the establishment of reserves in those districts most vitally affected and has already established several such, said reserves being necessary on account of the inability to secure a comprehensive fisheries code which could be readily administered and which would adequately protect these districts; and

Now, therefore, be it resolved, That it is the sense of the Pacific Fisheries Society in convention assembled at Los Angeles, California, September 17–20, 1923, that we heartily endorse the creation of the reserve referred to, and our Secretary is hereby instructed to send a copy of this resolution to the President of the United States, to the Secretary of Commerce, and to the United States Commissioner of Fisheries.

III.

RESOLUTIONS RE AN INTERNATIONAL FISHERIES TREATY AND AN INTERNATIONAL COMMISSION FOR THE STUDY OF FISHERY PROBLEMS OF THE NORTH PACIFIC, ADOPTED BY THE PACIFIC FISHERIES SOCIETY AT LOS ANGELES, SEPTEMBER 19, 1923.

Whereas, It is known that many valuable species of marine mammals such as fur seals, sea otters, elepnant seals and whales, and many species of important food fishes such as salmon and halibut, formerly occurred in the Pacific in such vast numbers as to constitute the objects of fisheries whose animal products were worth more than one hundred million dollars, and

WHEREAS, Nearly all of those great natural resources have been seriously depleted, many of them even to commercial extinction, through greed, short-sightedness and ill-considered fishery methods, and

WHEREAS, It is known that small remnants of fur-seal and sea-otter herds and small numbers of whales and of other commercially valuable species still remain in certain places, and

WHEREAS, The rapid recovery of the Alaska fur-seal herd in the short period of 10 years from complete commercial ruin to an annual production of more than $1,500,000.00, as a result of the international fur-seal treaty of 1911, demonstrates conclusively the wonderful recuperative power of such depleted natural resources of the sea under international cooperation, and justifies the belief that other depleted fisheries can be rehabilitated through similar cooperation among the nations concerned, and

WHEREAS, It is conservatively estimated that these resources when rehabilitated will yield to the world a regular annual product of more than one half billion dollars in value: therefore, be it

RESOLVED, That the Pacific Fisheries Society strongly urges the Honorable the Secretary of State to invite the various maritime countries of the world, particularly those bordering on, or interested in, the Pacific, to send delegates to a convention to meet in Washington at an early date for the purpose of negotiating an International Treaty for the restoration, proper utilization and conservation of the vanishing natural fishery resources of the Pacific; and, be it further

RESOLVED, That the Pacific Fisheries Society recommends that the governments of the countries bordering on the Pacific enter into correspondence for the purpose of establishing an International Commission for the scientific study of the biology, physics and chemistry of the Pacific in the interest of the restoration, proper utilization and conservation of its vanishing natural resources.

NATHAN FASTEN,
Secretary

THE WESTERN SOCIETY OF NATURALISTS

THE Western Society of Naturalists met on September 18 and 19, during the general meetings of the Pacific Division of the American Association for the Advancement of Science at the University of Southern California. On the morning of the eighteenth, the society had a joint session with the Cooper Ornithological Club, and in the afternoon a joint symposium with the Ecological Society of America. Immediately following the symposium Mr. Donald R. Dickey, of Pasadena, showed his beautiful motion pictures of the birds of Laysan Island before a large and very enthusiastic audience.

On Wednesday morning, the nineteenth, there was a short business meeting of the naturalists, at which the officers for the next year were elected as follows: H. B. Torrey, University of Oregon, *president*; Nathan Fasten, Oregon Agricultural College, *vice-president*; C. O. Esterly, Occidental College, *secretary-treasurer*; A. B. Ulrey, University of Southern California and Le Roy Abrams, Stanford University, *members of the Executive Committee*. After the business meeting there was a joint session with the Ecological Society for the presentation of papers of ecological interest.

Two sessions were necessary for Wednesday afternoon. At one of these, which was in conjunction with the Southern California Section of the American Society of Mammalogists, Mr. Dickey again delighted a large audience, this time with his motion picture, "Game trails of the north woods." The other session was for the reading of papers, most of which were concerned with physiology.

The following are the titles of the papers read at the different sessions:

Tuesday morning, September 18

Additions to the distribution records of the Drosophilinae of southern California: CATHERINE V. BEERS.

Sonic depth finder and some possible uses in marine biological collecting: W. C. CRANDALL.

The need of another international fur-seal treaty: BARTON WARREN EVERMANN.

Some observations on the bird life of Death Valley: J. GRINNELL.

Barriers in relation to species-forming: DAVID STARR JORDAN.

The geologic history of the fox sparrows: J. EUGENE LAW.

Some factors in fish classification: E. C. STARKS.

Notes on the present status of the band-tailed pigeon on the Pacific Coast: W. P. TAYLOR.

A remarkable Anthoceros: D. H. CAMPBELL.

Tuesday afternoon, September 18

Joint symposium with the Ecological Society of America. Subject: Evolutionary and ecological aspects of distribution.

The origin and affinities of the floral elements of California: LE ROY ABRAMS.

The ecological and distributional features of the deserts of California: FORREST SHREVE.

Isolation as an evolutionary factor, with special reference to birds and mammals in California: J. GRINNELL.

Some factors in the evolution of desert mammals: F. B. SUMNER.

Wednesday morning, September 19

Joint session with the Ecological Society of America.

Recent studies on microplankton of the southern California region: W. E. ALLEN.

Some features of the vegetation and the climate of arid South Africa: W. A. CANNON.

Factors in survival and growth of juvenile Unionidae: B. J. ANSON and A. D. HOWARD. (Read by A. D. Howard.)

Infertility of transplanted oysters: TREVOR KINCAID.

Wednesday afternoon, September 19

First session

Science publicity: W. E. Allen.

The sea environment of natural resources contrasted with that on the land in relation to conservation: Barton Warren Evermann.

International auxiliary language: present status and prospective value to science: H. B. Frost.

Life-history notes on the tree mouse of the humid coast belt: A. B. Howell.

Uniformity in the use and connotation of certain place names: E. C. Jaeger.

The biotic factor in forestry: E. C. Munns. (Read by A. G. Vestal.)

The conservation of upland game birds in the state of Washington: W. P. Taylor.

Conservation of fur seals: G. Dallas Hanna.

Second session

Experiments in the transplantation of the hypophysis in tadpoles: B. M. Allen.

Comparative stages in the spermatogenesis of various cancer crabs: Nathan Fasten.

Influence of time and temperature on the rate of growth of certain tadpoles: H. S. Fawcett.

Control of polarity and growth by means of the electric current: E. J. Lund.

Continuous production of electrical energy by Obelia: E. J. Lund.

The cytology and breeding behavior of two species hybrids of the genus Crepis: Margaret Mann.

Acid production in excised mammalian muscle: E. G. Martin and A. C. Ambler. (Read by E. G. Martin.)

The effect of oestruation on activity of the albino rat: J. R. Slonaker.

A comparison of the effect of desiccated thyroid and thyroxin on the structure and behavior of Paramecium: M. C. Riddle and H. B. Torrey. (Read by H. B. Torrey.)

The effect of desiccated thyroid on the color and moulting of the common fowl: Benjamin Horning and H. B. Torrey. (Read by H. B. Torrey.)

The inhibitory action of desiccated thyroid on the development of the testis in fowls: Benjamin Horning and H. B. Torrey. (Read by H. B. Torrey.)

Lutear cells and sexual dimorphism of feathering in wild birds: H. B. Yocom. (Read by H. B. Torrey.)

Demonstration: Life-history of the round sting ray, Urolophus halleri: A. B. Ulrey.

C. O. Esterly,
Secretary

PACIFIC BRANCH PALEONTOLOGICAL SOCIETY

The meeting of the Pacific Branch Paleontological Society was called to order by Vice-president A. O. Woodford at 9 a. m., on September 18, at the Los Angeles Museum of History, Science and Art, Exposition Park.

The following papers were then read:

Note on the fossil content of the San Rafael limestone of the San Rafael mountains, Santa Barbara County, California: M. C. Israelsky.

Marine Eocene horizons of Western North America: B. L. Clark.

A study of the faunal and stratigraphic relations of the Middle and Lower Miocene of the Santa Ana Mountains, Southern California: C. D. Meserve.

The cretaceous deposits of the Northern Andes: F. M. Anderson.

Fossil diatoms of California from a historical standpoint: C. Dallas Hanna.

The meeting adjourned for luncheon.

At 2.15 p. m. the meeting was again called to order by Vice-president A. O. Woodford and the following papers were read:

Protesting the species-maker: The point of view of the practical paleontologist: A. J. Tieje.

The western extent of the painted desert formation and its fauna: C. L. Camp.

Classification and relationships of the edentates of Rancho La Brea: C. Stock.

Program for further study of succession of faunas and floras in the John Day region of Eastern Oregon: John C. Merriam.

Chester Stock,
Secretary

THE ECOLOGICAL SOCIETY OF AMERICA

Tuesday morning, September 18

The problem of relative values in a life cycle: W. E. Allen. The paper emphasized the need of adequate attention to all stages of the life cycle, as well as to the particular stage immediately concerned in the problem at hand.

Field studies of carbon dioxide absorption by plant leaves: Forman T. McLean. (Read by title.) Methods and results of experiments on leaves of coconut, rice and sugar-cane were described. The food-manufacturing power of sugar-cane is lowered when the leaf-tips roll up at mid-day in dry weather. This lowering of rate becomes more marked as the drought period lengthens.

The leaf structure of Acacia: Howard De Forest. (Read by title.)

The influence of precipitation on growth of Monterey pine and redwood: Forrest Shreve. Diameter increase as indicated by rings in the stump is only a rough measure of increase at different heights in the trunk. Individual trees show very little agreement with each other and with the precipitation, except during a few of the years for which records are available. For these few years agreement was close. Tree-ring records should therefore be interpreted with caution.

California grassland vegetation in the vicinity of Palo Alto: Arthur G. Vestal. The chief dominants are Stipa setigera, Koeleria cristata and Melica imperfecta. Of the 150 grassland species of the area, 73 are annuals, a high proportion. The most conspicuous and abundant

plants are species of Calochortus, Brodiaea, Chlorogalum, Sisyrinchium, Ranunculus, Eschscholtzia, Lupinus, Trifolium, Nemophila, Linanthus, Orthocarpus and Baeria. The plants characteristic of moist habitats are in decline when those of dry habitats are reaching their peak (about April 25). A similar seasonal relation holds as between annuals and perennials.

Some relations of the Zuni prairie-dog to vegetation in northern Arizona: WALTER P. TAYLOR. The grazing ranges are seriously depleted by the prairie-dog, which eats the same grasses as do the cattle, in the same order of preference. The prairie-dogs eat almost as much as the cattle of most kinds of grasses, and more of one kind (drop-seed). They should be exterminated.

Studies in transpiration of tree seedlings: G. A. PEARSON. Yellow pine, Douglas fir and other trees were studied. Methods are being developed which permit comparison of different species, not in the conventional terms of water-loss per unit of leaf area, but in terms of the size of the plant, which is of greater moment in forestry.

Increase of growth-rate in cut-over yellow pine: HERMAN KRAUCH. (Read by G. A. Pearson.) Diameter growth was studied in a forest thinned 27 years before. Cores obtained with the increment borer were exhibited. The growth-rings formed after thinning were 3 to 6 times as wide as the earlier rings, showing most graphically the suppressing influence of competition.

Tuesday afternoon, September 18

Joint symposium with the Western Society of Naturalists: Evolutionary and Ecological aspects of distribution in California.

Floral elements and floral affinities in California: LE ROY ABRAMS. The present flora, recruited at different times from different sources, is made up chiefly of three elements: boreal, warm-temperate and west-American (or Mexican). A Californian element of restricted range, sometimes separately recognized, may be included in the west-American. There is also a slight representation of austral or south-hemisphere plants. Distribution-maps of selected genera were used for illustration.

Ecological features of the plant life of the desert: FORREST SHREVE. The California deserts are differentiated by the progressive increase of dryness eastward, into the fairly luxuriant desert-border vegetation of the western Mojave, with its Joshua-trees and other characteristic plants and the simpler, monotonous and far more resistant vegetation farther east, consisting chiefly of creosote-bush, with Franseria also. The creosote-bush is a truly remarkable plant to endure, as it does, rainless periods as long as 32 months. A further distinction between the California deserts and the quite different succulent desert of southern Arizona is caused partly by the lessening eastward of the winter rainfall from the Pacific, with gradual replacement farther east by late-summer rainfall from the Gulf of Mexico, and partly by the intolerance of freezing temperatures shown by most Arizona desert plants. The western Mojave and Arizona vegetations have remained distinct, due as much to intense aridity in the zone between them as to differences in ecological conditions.

Isolation as an evolutionary factor, with special reference to birds and mammals in California: JOSEPH GRINNELL. A concept of evolution as it actually occurs in nature. In a given isolated region it seems that the environment, by reason of the opportunities or places for individual kinds of animals which it may afford (ecological niches), plays a large part in determining the directions of the modifications which will occur in whatever animal material may be at hand. A new form which may arise does not become a species until it has successfully met the conditions of life as it finds them in nature. Species do not arise suddenly: the process requires time. This concept is a form of natural selection.

Some factors in the evolution of desert mammals: F. B. SUMNER. Desert animals are not so different from other animals nor so wonderfully endowed with resistant powers as some persons have thought. Small desert mammals, for example, do not withstand the heat and dryness of the soil surface, they avoid it by means of nocturnal and underground habits. While most desert animals must get along without drinking, succulent parts of plants are eagerly devoured when opportunity affords. The spininess of so many desert plants has undoubtedly contributed to their survival. Desert animals have evolved slowly from animals of adjoining environments.

After the symposium Mr. Donald R. Dickey's remarkable motion pictures of the bird life of Laysan Island were shown. Mr. Dickey told of the many ecological problems presented by this concentration of bird life in the Pacific. The expected reestablishment of vegetation on the island as a result of the extermination of the rabbits, which it is hoped was complete, and the possible effect upon the bird life, are developments which ecologists will await with interest. On Wednesday another series of pictures, on wild life in the New Brunswick forests, was presented. Moose, deer and other animals, as well as the modes of obtaining the photographs, were exceptionally well shown. In both series, the slow-motion analysis of animal activities was an outstanding feature.

On Wednesday morning the Ecological Society met again with the Western Society of Naturalists. The six papers presented were ecological in character, as were also a number of those in the afternoon program of the Naturalists.

The dinner for ecologists on Wednesday evening was held at a downtown coffee-house. The absence of speeches is a feature of this dinner.

On Thursday, September 20, a field excursion in the San Gabriel mountains was conducted by Dr. Philip Munz and Mr. Marcus E. Jones, of Pomona College. Chaparral, forest and valley scrub vegetation are very well shown in the route traversed. The visitors were delightfully entertained by the college people.

A. G. VESTAL,
Western Secretary

SCIENCE NEWS

CALIFORNIA EARTH MOVEMENTS AND EARTHQUAKES

Science Service

SLOW movements of the earth's crust are in progress in California, Colonel E. Lester Jones, director of the U. S. Coast and Geodetic Survey, who characterized them as "remarkable," reports to Science Service. The eventual result of the precise surveys showing these changes may be the prediction of the time and place of earthquakes within reasonable limits.

Field parties this year found irregular movements of the coastal region within 200 miles of San Francisco amounting to as much as 16 feet as compared with accurate surveys made 30 or more years ago.

The discovery of the movements was made possible by the survey's field operations under special congressional appropriations, and the cooperation of the Seismological Committee of the Carnegie Institution of Washington, headed by Dr. Arthur L. Day. The field work consisted in the redetermination of the latitude and longitude of certain peaks, principally of the Coast Range, and of certain lighthouses, the positions being determined by reference to two massive peaks of the Sierras, Mount Lola and Round Top. The actual measurements were made by two triangulation parties, one under C. L. Garner in 1922 and one this summer under F. W. Hough.

The movements shown bear a general relation to the famous San Andreas fault line, a slip along which was the immediate cause of the great earthquake of 1906. Points south and west of this line have with a few notable exceptions moved in a northerly direction; while those to the north and east of the line have nearly all moved toward the south. There is little uniformity in the amount of the movements.

For example, San José peak, about ten miles southwest of the fault line and about 40 miles inland from San Luis Obispo, has moved north 16 feet while Santa Lucia peak, 80 miles to the northwest, has moved only 7 feet northwards.

Near San Francisco bay the differences in direction are most marked. The lighthouse on South East Farallon Island has moved westward 6 feet, while Point Reyes lighthouse, on the mainland 18 miles away, has moved 11 feet to the north. Mt. Tamalpais has moved south about 5 feet.

Loma Prieta peak, about 50 miles southeast of San Francisco, has moved southeastward 6½ feet, while Sierra Moreno peak, about half way to San Francisco and on the opposite side of the fault line, has shifted 3 feet to the westward.

Major William Bowie, chief of the Division of Geodesy, under whose direction the work during the past two years has been done, says of the results:

"They are epoch-making and may lead to the eventual predicting within reasonable limits of the time and place of earthquakes. They will certainly have great influence on geologic thought in the study of the earth's crust. The remarkable thing is that the peaks do not move the same amount for any given direction, the complicated movements seemingly indicating the action of local forces rather than one of a world-wide origin.

"The results have much interest and value to the engineer, the surveyor and map maker, the geophysicist and the geologist. It has long been known that the earth moves horizontally along a fault line, but how far back from the fault does the movement take place? Our surveys found decided movements for stations 15 miles or more from the fault and the creeping of the surface probably is going on at even greater distances. Field work carried on in the future will reveal this. I believe the theory of isostasy must be taken into account in the explanation of what is going on in California and in other active earthquake regions."

MERCURY ENGINES

Science Service

THE first mercury engine in the world for the production of power in commercial quantity is now in operation in the plant of the Hartford Electric Light Company, whose officials predict a saving of from 40 to 50 per cent. of fuel by its use. The invention is essentially a turbine engine run by mercury vapor. The whole electrical industry is interested in observations being made of its operation.

Incentive for a careful investigation of the properties of mercury vapor for power generation is given by the high cost of coal and its transportation, making it necessary to minimize fuel consumption. The mercury boiler was started successfully at Hartford early in September and has since been in regular operation, carrying a part of the commercial load of the local lighting system. Officers of the local lighting company say that it has carried approximately 3,500 K. W. of the Hartford load.

While the present installation is not of sufficient size to have any effect on total cost of power produced by the company at the present time, it is large enough to provide a working basis to calculate the results that may be obtained eventually from larger sizes. The manufacture of these boilers is so intricate that it will probably be several years before the larger boilers can be in operation.

It is expected that the mercury boilers will be a very material improvement over the most modern stations, even those contemplating using 1,000 and 1,200 pounds of steam pressure. The new process will require only about one quarter of the fuel that is used with the best reciprocating engines.

The mercury vapor exhausted by the mercury turbine is sent to a condenser where it is cooled by water, just as in any ordinary power system. But the mercury vapor is so hot that the "cooling water" is turned into high-pressure steam. This steam is not wasted, but is sent to a steam turbine from which additional power is obtained. This still further increases the efficiency of the system.

SCIENCE

VOL. LVIII NOVEMBER 9, 1923 No. 1506

CONTENTS

SCIENCE: A Weekly Journal devoted to the Advancement of Science, edited by J. McKeen Cattell and published every Friday by

THE SCIENCE PRESS

Lancaster, Pa. Garrison, N. Y.
New York City: Grand Central Terminal.

Annual Subscription, $6.00. Single Copies, 15 Cts.

SCIENCE is the official organ of the American Association for the Advancement of Science. Information regarding membership in the association may be secured from the office of the permanent secretary, in the Smithsonian Institution Building, Washington, D. C.

Entered as second-class matter July 18, 1923, at the Post Office at Lancaster, Pa., under the Act of March 3, 1879.

NEW RESEARCHES ON CONDITIONED REFLEXES[1]

I HAVE the pleasure and the honor to present to the representatives of American science the results of my investigations. For the last twenty years I have studied the highest nervous activities of the dog, the functions of the cerebral hemispheres of the brain. These *functions* I have studied *only physiologically* on strictly physiological grounds. I never use any psychological conceptions or terms.

The basis of nervous activity is formed by so-called reflexes or instincts. The instincts are also reflexes, but more complex. The instincts—inborn associations with definite stimulators—correspond to the activities of the organism. On this basis are built the highest nervous activities.

If the action of any indifferent agent coincides in time with the action of an instinct, and if the action of the agent is repeated many times, then this agent, formerly indifferent, begins to stimulate the instinct. Here is an example:

Food stimulates the food reaction, which consists of some movements of the animal and secretion. If some indifferent agent, which previously had nothing in common with feeding, is repeated many times with the feeding of the dog, after a time it begins to stimulate the food reaction when used alone. If we produce some distinct musical sound, for instance, at a given rate of frequency of vibration per second—and always at the same time feed the dog, after a while this sound, used alone, will produce the same food reaction as the food itself.

Such stimulators may be formed from any agent of the outer world and with any other instinct. For example, the self-protective instinct, the sexual instinct, and so on, have both the individual reflexes and the social reflexes. In this way, besides the reflexes or instincts which are inborn, there are some reflexes acquired during the life of the individual. The first, or inborn, reflexes we call unconditioned reflexes and the second, or acquired, reflexes we call conditioned.

It is clear that the conditioned reflexes play a very important part in our behavior, as they are being acquired all during the life of the individual and are the education and the development of the individual.

[1] Address given at Battle Creek Sanitarium, July 7, 1923. Translation furnished by Professor W. N. Boldyreff, Pawlow Physiological Institute, Battle Creek Sanitarium.

These conditioned stimulators serve as signals separate from the unconditioned stimulators and, like any other signals, they may not signalize properly. Then they ought always to be corrected.

For instance, in the experiments mentioned the sound produced by one thousand vibrations per second was made a conditioned stimulator. If the sound is repeated without the simultaneous feeding of the dog, then for some time the sound loses its stimulating action. But this does not destroy the conditioned reflexes. Sometimes the stimulating action returns again. Here is another example: If the conditioned stimulator is combined with another agent—any other agent—and is not at the same time combined with feeding, then in this combination the conditioned reflex loses its stimulating action.

In both these cases we deal with inhibition. In this way the process of inhibition always accompanies the activity of the highest nervous centers. The process of inhibition exists for another end. It helps to differentiate the various stimulations from the outer world. For instance, let us form from the sound caused by one thousand vibrations per second a conditioned stimulator for the food reaction, which means this sound always produces the ordinary food reaction or the secretion of saliva. After this secretion reaction was formed to this particular sound all the sounds of the neighboring frequencies, say, 960 vibrations or 1,100 vibrations, also produced the same effect; that is, all the sounds of nearly the same frequency acted as stimulators for food reaction. Yet it is possible to reach a high grade of differentiation. If we always produce only sounds caused by one thousand vibrations with the feeding of the dog, carefully excluding all the other sounds, after a time all the other sounds will lose their stimulating action and only the one sound, that caused by one thousand vibrations per second, will act as a stimulator for the food reaction. In this way, the limit of the differentiating ability of the dog or of any other animal may be very easily found. It was shown that the dog very easily differentiates 110 beats per second of the metronome from 100 beats per second, sometimes after intervals of one to three days between experiments.

In this way conditioned reflexes and analysis make up the whole activity of the nervous system. It is interesting to point out that recently we have proved that the process of inhibition which plays a part in the nervous activity of the animal is exactly the same process as that of sleep. It may be stated as follows: The differentiating inhibition in sleep is divided into small parts, and sleep is the diffused continuous inhibition. In this way there is no marked contrast between the normal, active state and the sleepy state. Here are some proofs.

All cases of inhibition may produce sleep unless some special precautions are taken. The differentiation of sleep just mentioned, the special measure which prevents the inhibition from causing sleep, is indeed the existence of stimulating points in the cerebral hemispheres of the brain. The process of stimulation interferes with the process of inhibition and reduces it to a limited space. In some experiments we have seen how slowly the process of inhibition spreads over the cerebral hemispheres. The speed of the movement of inhibition is measured not only in seconds but sometimes in minutes. The process of stimulation irradiates much more qiuckly.

From this point of view some of the phenomena of hypnosis may be understood. Hypnosis is the very slow-spreading process of inhibition. To illustrate this, the following experiment on the dog may be described. We can produce some inhibition in one of the experiments which were mentioned. If we do not interfere with this process of inhibition through the radiation of stimulation, then after some time the process of inhibition is converted into sleep; and the sleep may be stopped in the following interesting stage or phase. We use the conditioned food stimulator. The dog responds to it with the secretion of saliva, but when we offer him food he does not take it. The food reaction, the saliva reaction, shows first that some part of the cerebral hemispheres is active; and, second, the fact that he does not take the food shows that the motor part of the hemispheres is inhibited. We have here a complete analogy to a known state of hypnosis. When in a certain definite state or phase of hypnosis, the hypnotized man understands perfectly well what he is told and even remembers it afterwards, but is not able to produce any movement. That is absolutely analogous to the previous case; but only the motor part of the cerebral hemispheres is inhibited in the last example. In this way these experiments illustrate not only the active state of the cerebral hemispheres but also the sleeping state.

The latest experiments (which are not yet finished) show that the conditioned reflexes, *i.e.*, the highest nervous activity, are inherited. At present some experiments on white mice have been completed. Conditioned reflexes to electric bells are formed, so that the animals are trained to run to their feeding place on the ringing of the bell. The following results have been obtained:

The first generation of white mice required 300 lessons. Three hundred times was it necessary to combine the feeding of the mice with the ringing of the bell in order to accustom them to run to the feeding place on hearing the bell ring. The second generation required, for the same result, only 100 lessons. The third generation learned to do it after 30 lessons.

The fourth generation required only 10 lessons. The last generation which I saw before leaving Petrograd learned the lesson after 5 repetitions. The sixth generation will be tested after my return. I think it very probable that after some time a new generation of mice will run to the feeding place on hearing the bell with no previous lesson.

It is well known that a chicken when it just comes from the egg immediately begins to pick up any black spot on the floor, trying to find some grain, thus showing that it has an inborn reflex from the eye to the food reaction. Why should we not build up the same reaction, not from the eye but from the ear as indicated in the case of the white mice?

The experiments in this direction with sound show very great progress. We obtained a great many results in a very short time. Similar experiments were made on men, with analogous results. We do not see any future difficulties, and at the same time the subject is of very great importance.

My firm belief is that the best way to a knowledge of the mechanism and the laws of our subjective world lies in the direction of the pure physiology of the hemispheres. In this way, in trying to estimate the influence of physiology in human life, we often acquire an unexpectedly large view.

All the rules for education and development ought to be taken from physiology. This opinion I have endeavored to support in this lecture by a short description of some of my experiments.

I. P. Pawlow

Petrograd, Russia

ON THE FUNCTION OF THE CEREBELLUM

It is now ninety-nine years since Magendie taught that the function of the cerebellum is to regulate our bodily equilibrium. Flourens (1842) emphasized the fact that it helps to bring our complicated muscle-action into harmonious relation and that cerebellar symptoms are purely motor and not based upon any form of sensory disturbance; Lussana regarded it as the central organ of muscle-sense. Until that time these authors had confined their studies to the well-ordered higher work of the cerebellum; later it was analyzed with regard to elementary function.

After twenty years' experiments (1884–1904) Luciani found, after removal of the cerebellum, three important functions missing, the loss of which he designated as atonia, asthenia and astasia. Directly after extirpation of the cerebellum there appear hypertonia of the muscle in the form of opisthotonus, and later hypotonia or atonia, or, in the inclusive terminology of Lewandowsky, cerebellar dystonia. This leads to dysmetria and by oscillation and jerkiness of the body to astasia.

In the opinion of Babinski, atonia is an unimportant symptom, a simple matter of muscle softness, and asthenia is not a true weakness, but simply the result of the violence of distorted movements. André-Thomas, who has combined experimental and clinical researches, regards atonia as of rare occurrence and asthenia as not cerebellar in origin.

Gordon Holmes, who has studied the cerebellar symptom-complex of the acute lesions produced by gunshot wound, agrees with Luciani that atonia, asthenia and astasia are fundamental defects of functions in cerebellar lesions, but he interprets them somewhat differently from Luciani. Babinski proposed to give the designation "adiadochokinesis" to the loss of the faculty of voluntarily executing rapidly alternating movements when the simple component movements are carried out with normal celerity. Holmes defined atonia as the diminution of that slight constant active tension which is characteristic of normal muscle, and regards it as a factor in the production of Babinski's adiadochokinesis. Luciani applies the term "dysmetria" to the violent and disordered movements in walking, involving excessive expenditure of energy, which are noticeable in a dog without cerebellum. He explains it as the premature relaxation of the extensors during the flexion phase of the step, and conversely premature relaxation of the flexors during the extension phase, so that the foot is lifted too high, or planted on the ground with a stamp. In Holmes's theory it depends upon a faulty combination of muscular contractions and is due to delayed muscular relaxation or ill-proportioned range and force of movement. Babinski calls it *gaspillage d'énergie* or waste of energy, assuming that the arresting action of the cerebellum upon muscular contractions is destroyed by extirpation or disease.

In the complex combination or sequence of several simultaneous movements, there is another disturbance which we call "asynergia." According to Holmes, it is the absence or disturbance of that proper synergic association in the contraction of muscles which assures that the different components of an act follow in proper sequence, at the proper moment, and are of the proper degree, so that the act is executed accurately and with the least possible expenditure of energy. In his opinion adiadochokinesis depends upon atonia, asynergia, dysmetria and delayed contraction and relaxation of muscles, while André-Thomas regards it simply as a natural result of dysmetria.

The opinions of these different authors are so far asunder that, as Walshe has said in his summary of the reports, "the hypotheses are couched in such vague and general terms as to be little more than restatements of an unsolved problem, while the analyses are diverse and do not reach the fundamental

factors of cerebellar ataxy." Nevertheless, we regard adiadochokinesis, dysmetria, asynergia and ataxia as important symptoms in the diagnosis of cerebellar affections, and they render good clinical service. Of course we shall not cease to seek better signs to enable us to perceive the functions and pathology of the cerebellum.

The localization of function is less well known in the cerebellum than in the cerebrum. What Bolk supposed on the ground of comparative-anatomical study, and what Rynbork, Rothmann and others made probable by experiments on animals was proved in the human cerebellum by Barany's physiological and clinical research, that there are areas of the cerebellar cortex which correspond to the extremities. In the first place, the muscles of the extremities are represented in the cerebellum by directions of movements, that is to say, there exist four centers, those for right, left, upward and downward. In the case of rest there goes from the four centers to the muscles of the extremities a tonising impulse; and thus equilibrium is maintained. If, for example, the left center is suddenly destroyed, the right extremity moves vertically to the right side, because the left center having disappeared, the right becomes overweighted. If the upper center is destroyed the extremity moves in a horizontal direction in analogous manner downward. The centers for all these movements are localized on the cerebellar hemispheres in the *lobus semilunaris superior et inferior* and in the *lobus biventralis*. Only the site of the center for upward movements of the arm is unknown. The action of these centers is like that of two bridles, the relaxation of one causing the overweight of the other.

If we now examine the cerebella of fish, we find that the apparatus for maintaining equilibrium of the body in the amphioxus, cyclostome and plagiostome is not yet well developed. The Teleostei have, in the medulla oblongata, large cells called Mauthner's cells, which have the function of maintaining equilibrium. Moreover, in this class of fish the "back-cerebrum" is also well developed, corresponding to the cerebella of other animals. We see further that the cerebellum is almost absent in a variety of skate which stays at the bottom of the sea practically motionless, while in the common variety which swims, it is well marked. It is also very interesting to see that the cerebella of fish have several different, sometimes very curious, shapes: standing up straight or lying down forward or backward, according to the species. The largest cerebellum is to be met with in Mormyridae, to which belong *Mormyrus kanume, Petrocephalus sp.* and *Gnathonemus cyprinoides,* inhabitants of muddy water and swimmers in thickets of water-plants. They do not swim quickly, but are very nimble and vivacious with constant movements of fins, as they wind their way between the aquatic plants. The cerebellum of the Mormyridae is most hypertrophic and overlies all other parts of the cerebrum in the same manner as the human cerebrum is excessive in growth compared with that of other mammals.

Let us consider the cerebella of mammals which live in water, such as the whale, the seal, the otter, etc. As compared with fishes they all have a much better developed cerebellum, especially the seal, which is less accommodated to life in water and whose nimble movements we all know. Life in water leads, generally speaking, to atrophy of the cerebellum and particularly of the vermis or middle lobe, while the hemispheres remain in good condition.

The human cerebellum is well developed for the purpose of upright walking, because it is much more difficult to maintain bodily equilibrium on two feet than on four. Moreover, in the human being it regulates the coordination of speech. Not only the movements of tongue, lips and vocal cords must be well coordinated, but also the superficial and deep sensibility of mouth, throat and larynx must be well developed. Great orators need not only a well-developed center for articulate speech in the cerebrum, but also a well developed cerebellum, so that the cerebellum shall work under the control of the cerebrum and vice versa.

KINNOSUKE MIURA
IMPERIAL UNIVERSITY OF TOKYO

WORK OF THE NATIONAL RESEARCH COUNCIL

(Continued)

Division of Research Extension.—The council's division of research extension, which is especially interested in the promotion of industrial research, has been the special representative of the council in connection with its relation to the organization of the Crop Protection Institute, the Horological Institute and the important committees on corrosion problems, alloys problems, textiles research, the making and use of scientific instruments, etc. The officers of this division have also the special function of the active solicitation of funds from industrial concerns and other organizations and men for the support of any and all of the council's special projects which relate to the applications of science, whether these projects are directly under the control of the division of research extension or of other divisions, as those of physics, chemistry and chemical technology, biology and agriculture, etc.

The division has been specially active during the past year in arranging for certain important conferences, in promoting the financial support for the International Tables of Critical Constants and for the

Marine Pilings Investigations; in developing in co-operation with the U. S. Bureau of Standards and the American Home Economics Association a program for textiles research, in finding money from industrial companies for the preparation and publishing of a revised edition of the council's important bulletin on American research chemicals, and other similar undertakings.

Research Information Service.—The council's research information service, which serves as a clearing house for information concerning research work and workers, has built up a considerable equipment in the way of mechanisms for collecting, arranging, cataloguing and distributing information. During the past year it has answered about 2,000 outside requests for information, besides as many from the council offices and from institutions and men in Washington. It has compiled and published in the council's bulletin and reprint and circular series a considerable amount of information useful to research workers and scientific men generally, especially in the way of lists of published and unpublished (manuscript) bibliographies in various special scientific fields as well as a number of bibliographies both published and unpublished, but available for reference. It has also prepared and published an account of handling personnel data, and an account of methods of author's automatic abstracting.

The personnel file of American scientific investigators has been steadily increased during the past year. It now includes about 14,000 records. A summary of the activities of American psychologists has been prepared for publication. Progress has been made in the development of a general catalogue of sources. Progress has also been made on assembling matter for revisions of two earlier important informational publications of the service, namely, "Funds available in the United States for the encouragement of scientific research" and "Research laboratories in industrial establishments of the United States, including consulting research laboratories."

In the latter part of July and August, 1922, Mr. J. David Thompson of the service visited about three fourths of the industrial research associations in England, organized by means of government aid, and collected valuable data concerning their work, particularly their research informational activities. Mr. Thompson also prepared a special report on the scientific informational services of the world.

Division of Physical Sciences.—The council's division of physical sciences has devoted during the past year, as during the two years before, its principal attention and support to the work of the important series of special committees on various particular physical, astronomical and mathematical subjects or fields, whose work has been made possible by a gift of $30,000 from the Rockefeller Foundation for the first two years and an appropriation by the council of $5,000 for this past year. These committees have been composed of eminent specialists in their respective particular fields who have given much time and energy to the work of the committees. The following is a list of the fields of work of these committees: acoustics, algebraic numbers, atomic structure, celestial mechanics, electrodynamics of moving media, luminescence, mathematical analysis of statistics, orbit theory, parallaxes, photo-electric effects, physiological optics, quantum theory, radiation in gases, research methods and technique spectroscopy, theories of magnetism, thermo- and magneto-electrical effects, vision and photo-biology, x-rays and radio activity and x-ray spectra.

The carefully prepared reports of seven of these committees have been published during the past year in the council's bulletin series. Altogether thirteen reports have been published. The report of the Committee on the Mathematical Analysis of Statistics is to be published in book form by Houghton, Mifflin and Company.

Division of Engineering.—The council's division of engineering, through which the council maintains its contacts with the major engineering societies of the country and especially closely with Engineering Foundation, has been reorganized during the year consequent upon certain changes in the organization of Engineering Foundation. By the new arrangement, Dr. F. B. Jewett, vice-president of the Western Electric Company, becomes chairman of the division of engineering; and the president of the foundation becomes *ex-officio* a member of the executive board of the National Research Council.

The various activities and special research projects of the division of engineering are too numerous to mention with any approach to completeness in this report, but reference may be made to a few of them. Altogether there are now about twenty special boards and committees of this division.

The Advisory Board on Highway Research, which has been working in close cooperation with the U. S. Bureau of Public Roads, has made a number of reports of its work which have been published. It held its second annual meeting in Washington, November 23, 24, 1922, with a large attendance of leading highway engineers. Investigations of highway problems involving expenditures of more than one million dollars are now under way in America under the direction of various federal and state bureaus. The advisory board through its director and committees has been active in stimulating these investigations and has given much helpful information and advice in connection with them.

The work of the various committees of the Advisory

Board on Welding Research has made much progress during the year. The Committee on Pressure Vessels, for example, has been able to finance its work to the extent of about $15,000 by gifts from eight manufacturing concerns, and through cooperation with the U. S. Bureau of Standards, has completed a special research involving the testing to destruction of forty pressure tanks by the bureau. The committee on welded rail joints has instituted a comprehensive research involving, with contributed materials and services, the use of a sum exceeding $80,000. Steel companies, manufacturers of special joints, electric railway companies, university laboratories, U. S. Bureau of Standards, and various technical societies are cooperating in this work.

In connection with the work of the important joint committee of the Division of Engineering and the Division of Biology on marine pilings investigations, money and service contributions have been received from numerous sources. The most recent of these items has been the pledge of an appropriation of $10,000 each from the Quartermaster Corps of the Army and the Bureau of Yards and Docks of the Navy to be expended on work by the Chemical Warfare Service through two years.

The committee on fatigue phenomena on metals, which has been carrying on an important research in the laboratory and under the direction of Professor H. F. Moore, of the University of Illinois, has been well supported financially and has made conspicuous progress. In addition to original contributions of $30,000 each by Engineering Foundation and General Electric Company together with service, facilities and supplies from the University of Illinois and several corporations approximating $25,000, the General Electric Company has recently added $7,500 and informally indicated its willingness to appropriate $7,500 more if other industries will contribute a total of $15,000. Plans have been made for extending the investigation to non-ferrous metals besides continuing the studies on steels.

The committee on Neumann bands prepared a report which was published by the American Institute of Mining and Metallurgical Engineers. This committee is continuing its investigations with the cooperation of the Army and Navy to ascertain whether the presence of Neumann bands in steel is an evidence of weakness.

The committee on hardness testing of metals, the work of which is of especially fundamental nature, has made certain reports and has secured effective cooperation in its work from government laboratories, industrial companies and the American Society for Steel Testing. The committee on heat treatment of carbon steel has prepared a comprehensive report of its work which is to be published in the Transactions of the American Institute of Mining and Metallurgical Engineers. This committee has been recently reorganized for the purpose of completing the work originally outlined for it under the chairmanship of the late Dr. Henry M. Howe, and of planning new investigations of a fundamental nature.

The molding sands committee is making active progress with its work. Cooperation has been secured from state geological surveys for recording foundry sand deposits. Standard tests have been prepared for fineness and special progress has been made in determining standard methods for chemical analysis, rational analysis, permeability tests and sampling.

The full time services of a secretary have been provided for the committee on pulverizing through the cooperation of the U. S. Bureau of Mines, University of California and Massachusetts Institute of Technology. It is estimated that the total funds and services so far made available to this committee amount to more than $50,000 a year.

Division of Chemistry and Chemical Technology.—The council's division of chemistry and chemical technology has given much of its attention and energy during the past year to advancing the interests and work of the International Critical Tables of Chemical and Physical Constants. The present chairman of the division is the editor-in-chief of the Tables, and has associated with him a staff of two associate editors, two assistant editors and a group of ten corresponding editors representing as many European countries. This editorial board is now steadily at work and has completed its plan for the whole program. It has arranged with about a dozen physicists in as many different American colleges and universities to undertake special investigational work on the physical properties of various materials. Close cooperation with the international board of annual critical tables, with headquarters in Paris, has been set up. The total expense of the work of preparing and publishing the International Tables is estimated at about $200,000, of which about $100,000 in money and services have been so far pledged and partly paid in and rendered.

The division's committee on explosives investigations has been very active during the year and important reports of its work have been published. The committee has given a special attention to the matter of the utilization of surplus explosives now in the hands of the government and has shown by experimental demonstration how these explosives may be safely and advantageously employed in the industries. Through the work done by this committee on TNT, modified TNT and picric acid it is officially stated that more than $10,000,000 worth of useful explosives material has been rescued from waste.

The committee on chemistry of colloids has completed a bibliography of the literature in this field, containing eighteen hundred references together with brief descriptive statements of the ground covered by each paper. Also a list of research problems in colloid chemistry was prepared by the chairman of the committee and has been in great demand, the first edition having been already exhausted in meeting requests for it. The committee on research chemicals has arranged for a revision of the council's bulletin on "American Research Chemicals." Part of the expenses of this revision and its publication will be met by gifts which have been pledged by various chemical manufacturers. The first report of the committee on contact catalysis has been published in the Council's Reprint and Circular Series.

Division of Geology and Geography.—The council's division of geology and geography has, during the year, brought several of its current undertakings to approximate conclusion. The important work of Dr. Ernest Antevs on "The Recession of the Last Ice Sheet in New England," which was first taken up and supported by this division and later supported by other organizations, has been finished and published in the Research Series of the American Geographical Society. A bibliography of published geological bibliographies has been completed, in cooperation with the Research Information Service, and published. The work of preparing and classifying a list of American working geologists and geographers is practically completed. Considerable time has been given to cooperation with the Federal Bureau of Surveys and Maps in an effort to bring about the completion of the topographic maps of the United States.

In response to requests from petroleum geologists, working in the field, for means to enable them to be placed in touch with laboratory and university workers on the principles and theory of petroleum formulation and accumulation, a special committee of the division is undertaking to list and describe all researches in geology, physics, chemistry and biology which should be of use to the theoretical student of petroleum geology. Efforts have been made to encourage the preparation of geological abstracts. It has been definitely agreed by the division and the U. S. Geological Survey that the division will participate in the survey's undertaking to prepare a dictionary of the technical terms used in physiography.

Preliminary work has been done by the chairman of the division looking toward a plan for conserving and ultimately publishing the valuable scientific results of commercial explorations, especially by American companies, in foreign countries. There has been much unreasonable secrecy and ultimate loss of information in connection with such work. The publication of certain results of the House Inquiry jointly by the division and the American Geographical Society has been brought to completion. The division has approved as a project the preparation of a complete catalogue of all maps of Latin America by the American Geographical Society and the council has made a small appropriation through the division for this purpose. Considerable preliminary work has been done on a subject involving shoreline studies. The plan contemplates the cooperation of various government bureaus, several state surveys and state universities. The ultimate aim of the work is the forecasting of future changes of the shoreline.

The division arranged for four conferences to be held under the auspices of the division in connection with the mid-winter meetings of the various national societies of geology and geography. Three of these conferences have reference to the work of the division's committees on tectonics, sedimentation and geography. The fourth was a general round-table of geologists and geographers in which the work of the division was discussed.

Division of Medical Sciences.—The council's division of medical sciences has given much of its time and attention during the past year to the important matter of the administration of the research fellowships in the medical sciences which the council is enabled to maintain through the financial assistance of the Rockefeller Foundation and the General Education Board. Thirty-one fellows have so far been appointed. The chairman of the division, who is also chairman of the fellowship board, has recently made a trip of visitation to all the active fellows and he states that after careful inspection of the work of each one, after approximately six months of activity, he believes that no significant mistake was made in any individual appointment.

The division has carefully considered and approved a report of the Committee for Research on Sex Problems outlining the work accomplished during the past year and proposing a plan for the work in the future. (See reference to this committee earlier in this report.) The division's committee on abstracting current medical literature is recommending that all editors of medical journals in this country be requested to ask or require that an author's abstract of each article be sent with the article. This is in line with the important movement now being forwarded by other divisions of the council toward the development of an abstracting system in connection with scientific publication in this country.

The committee on investigation of deaths from tuberculosis in Colorado has presented a report which meets the warm approval of the division. This committee has undoubtedly made an important contribution to the epidemiology of tuberculosis and particu-

larly to the knowledge of the beneficial effect of climate in reducing the mortality from this disease. This extensive work has been carried out expeditiously and economically on the basis of a grant of $1,000 from the council.

Division of Biology and Agriculture.—The council's division of biology and agriculture has been much gratified by the recent successful outcome of negotiations with the Rockefeller Foundation which have resulted in the gift by the Foundation of $325,000 for the establishment and maintenance during the five-year period, July 1, 1923–June 30, 1928, of a series of research fellowships in the biological sciences, including anthropology and psychology. The special board of control has already been organized and has so far appointed nine fellows.

In addition the division has at its disposal nine special research fellowships for the scientific study of the uses of sulphur in agriculture, which are supported by certain industrial sulphur companies, and a single special research fellowship for the support of the work of Dr. Just, a negro biologist of Howard University, the funds for which are provided by Mr. Julius Rosenwald, of Chicago.

The division's committee on the Relations of Insects to Flowers carried on planned field work in Colorado last summer, the results of which have been published in a number of papers. This work was accomplished by the cooperation and support of the council, the American Museum of Natural History, Cornell University and the University of Colorado. The Committee on Food and Nutrition has carried forward and arranged for publication the work on protein metabolism in animal feeding begun under the leadership of the late Dr. H. P. Armsby. The results of investigations in the field of human foods carried on with the aid of a grant from the National Glass Containers' Association have been prepared for publication. Of the special funds available to the Committee on Food and Nutrition, $2,000 have been assigned to work on the relation of fertility to nutrition to be carried on under the direction of Dr. H. N. Evans, of the University of California.

The work of the Committee on Atmosphere and Man has made arrangements with the National Industrial Conference Board for the carrying on of extensive experimentation on the relation of atmosphere in factories to the efficiency of workers. The expense of the investigation will be provided by the National Industrial Conference Board.

As a culmination of the activity of the American phytopathologists over a rather long period and after a final conference in December, 1922, a project for the establishment of a scientific institute, to be known as the American Tropical Research Institute, was presented to the division and approved by it. The council has provided a small sum for an organizing meeting of a committee on phytopathology in the tropics and their advisers to formulate definitely the plans for the institute. Assurances of financial support have been received from commercial companies interested in tropical agriculture.

Division of Anthropology and Psychology.—The council's division of anthropology and psychology actively cooperated with the division of biology and agriculture and with the secretary's office in the negotiations concerned with the establishment of the research fellowships in the biological sciences, which are interpreted to include both anthropology and psychology, and which have been referred to earlier in this report.

The council's important Committee on Scientific Problems of Human Migrations, also earlier referred to in this report, had its origin in the division of anthropology and psychology and the division has given much attention to its program of work. An important conference on the subject of this committee's interest was held in the council rooms on November 18, 1922, which was attended by a distinguished group of men representing the fields of biology, psychology, medicine, public health, sociology and economics.

The division's important committee on vestibular research has been one of the council's most active committees and the results of its work have already been of high scientific value. It reports the preparation of an extensive comparative study of vestibular functions and the publication of experimental investigations on "Thresholds of Rotation," and the "Adequacy of Reflex Compensatory Eye Movements," and also "An Historical Survey of Vestibular Equilibration." The committee further reports the successful operation of the first clinical instrument for photographing the reflex vestibular deviations of the eyes of patients during rotation.

The Committee on State Archeological Surveys has prepared a brief manual to be used in connection with its work of interesting states in local archeological surveys. The Committee on Psychological Abstracts reports progress in its negotiations for the ultimate control by the American Psychological Association of an abstract journal which was initiated by the Psychological Review Company.

The Committee on Personnel Research in Business and Industry has cooperated in supporting the program of research on motivation in industry by Professor Elton B. Mayo, of Adelaide University, Australia, who has been in this country during the past year. The Committee has also cooperated with the Institute for Government Research in securing the services of Dr. L. L. Thurstone for the newly founded Bureau of Public Personnel Administration.

VERNON KELLOGG,
Permanent Secretary, National Research Council

SCIENTIFIC EVENTS

THE TWENTY-FIRST INTERNATIONAL CONGRESS OF AMERICANISTS

In accordance with the resolution adopted by the Twentieth International Congress of Americanists held at Rio de Janeiro in 1922, the Twenty-first Congress will be held at The Hague and at Gothenburg.

Arrangements have been made for holding the first part of this congress in the Netherlands at The Hague from Tuesday, August 12, to Saturday, August 16, 1924, the second part to be held in Sweden at Gothenburg from Wednesday, August 20, to Monday, August 25.

The Hague session will deal with subjects of general nature, North America, the Antilles and Guiana. In Gothenburg papers will be read on subjects of general nature, South America, Central America and the Esquimaux.

Care will be taken to provide a means of conveyance from The Hague to Gothenburg at a reasonable charge. Side trips will probably be arranged to Stockholm, Christiania and Copenhagen; and following the session anthropological congresses of importance will be held in Prague. It is very desirable that titles and abstracts of communications be received both for The Hague and for Gothenburg at an early date so that the detailed program may be prepared as soon as possible.

Communications may be oral or written. The time allotted for the reading of papers is fifteen minutes; but exceptions may be made in the case of subjects of especial interest and importance. The acceptance of more than two communications by one author will be subject to decision by the council. For discussion of papers the time limit will be five minutes for each speaker. All papers presented at the session will be submitted, after the conclusion of the congress, to the committee of publication, and if approved will be printed, with a limited number of illustrations if necessary, in the proceedings of the congress.

The addresses of the Secretaries General of the two sessions are: Dr. D. Albers, Van Oldenbarneveltlaan 61, The Hague, Netherlands, and Dr. Erland Nordenskiöld, The Museum, Gothenburg, Sweden. Subscriptions (10 Dutch guilders and 15 Swedish crowns) may be sent either to the secretaries, or to Dr. Aleš Hrdlička, U. S. National Museum, Washington, D. C.

THE BOSTON MEETING OF THE AMERICAN PUBLIC HEALTH ASSOCIATION

The Fifty-second Annual Meeting of the American Public Health Association was held in Boston, Massachusetts, October 8–11, 1923, with more than nine hundred sanitarians in attendance. The following scientific sections met to hear specially selected papers in their respective fields: Public Health Administration, Laboratory, Vital Statistics, Sanitary Engineering, Industrial Hygiene, Food and Drugs, Child Hygiene, Public Health Nursing, Health Education and Publicity.

There were two evening general sessions, one on October 8, and the other on October 10. The program of the first consisted of addresses of welcome from local health and civic leaders, including the Honorable James M. Curley and a representative of the governor, and the presidential address of Dr. E. C. Levy. A reception followed, at which there was dancing. At the second general session, Dr. George E. Vincent, president of the Rockefeller Foundation, talked on "Weighing the Ounce of Prevention"; Sir Thomas Oliver, the English industrial hygienist, presented a paper on "American leadership in safety and sanitation in modern industries"; and Dr. Linsly R. Williams, managing director of the National Tuberculosis Association discussed "Coordination of national health work."

Four meetings of the governing council of the association were held, and among other important matters of business, it was voted: (1) To hold the 1924 annual meeting in Detroit, Michigan. (2) To accept the New Jersey Sanitary Association as an affiliated state public health society. (3) To cooperate with the American Water Works Association in the preparation of standard methods for the examination of water. (4) To accept the hitherto provisional sections on public health nursing, and health education and publicity, as regular sections.

The association elected officers for the year 1923–1924 as follows:

President, William H. Park, M.D., New York City.

Vice-presidents, Francis X. Mahoney, M.D., Boston, Massachusetts; John W. S. McCullough, M.D., Toronto, Ontario; William H. Davis, M.D., Washington, D. C.

Treasurer, Roger I. Lee, M.D., Boston, Massachusetts.

Executive secretary, James A. Hayne, M.D., Columbia, S. C.

The office of executive secretary was made an unsalaried and honorary post, and the title of the executive officer was changed to general secretary. Mr. Homer N. Calver, who has been the acting executive secretary, was appointed to this office.

SEMINAR ON CONTEMPORARY CHEMISTS

The Department of Chemistry of the University of Pittsburgh has arranged a seminar to be conducted on Fridays at 2.20 p. m. in Thaw Hall. Twenty-four contemporary European chemists are the topics of discussion during the year. The graduate student is expected to present a biographical sketch of the chemist assigned to him, followed by a discussion of his

most important publications. Wherever possible the student is requested to exhibit a recent photograph and publications of the scientist under discussion. A typewritten copy of the matter to be presented must be submitted to the professor in charge of the field of chemistry covered, on the Saturday preceding the seminar period.

While this course is intended primarily for graduate students majoring in chemistry, others interested in any of these topics are cordially invited to attend the seminar. The program is as follows:

Oct. 5, 1923	—J. L. Young	H. G. J. Moseley
Oct. 12, "	—J. E. Rosenberg	F. W. Aston
Oct. 19, "	—A. N. Parrett	F. Soddy
Oct. 26, "	—W. L. Nelson	M. & Mme. P. Curie
Nov. 2, "	—E. W. Felkel	Niels Bohr
Nov. 9, "	—J. Nevyas	W. Nernst
Nov. 16, "	—E. W. Ohl, Jr.	Wilhelm Ostwald
Nov. 23, "	—R. A. Gagnon	J. Perrin
Dec. 7, "	—E. R. Clarke	T. Svedberg
Jan. 4, 1924	—W. A. S. Wright	Wolfgang Ostwald
Jan. 11, "	—R. McClure	K. Szigmondy
Jan. 18, "	—W. A. Rudisill	P. Sabatier
Jan. 25, "	—J. Lebarthe	W. Ramsay
Feb. 8, "	—A. H. Weitz	J. H. Van't Hoff
Feb. 15, "	—W. W. Lewers	M. LeBlanc
Feb. 29, "	—L. D. Myers	S. Arrhenius
Mar. 7, "	—R. E. Flikkema	E. Fischer
Mar. 14, "	—J. F. Conn	H. von Baeyer
Mar. 21, "	—H. J. Robertson	F. Haber
Mar. 28, "	—C. G. Denny	H. Moissan
Apr. 4, "	—A. E. Wood	P. Ehrlich
Apr. 11, "	—E. S. Ross	J. W. Mellor
Apr. 25, "	—G. D. Kammer	G. Lange
May 2, "	—Miss L. V. Hjort	L. Pasteur

THE AMERICAN SOCIETY OF ZOOLOGISTS

THE American Society of Zoologists will hold its twenty-first annual meeting at Cincinnati from Thursday to Saturday, December 27–29, 1923. The society headquarters will be at the Hotel Gibson which will also serve as headquarters for the botanists, naturalists and geologists.

Professors N. K. Koltzoff and P. P. Lazareff, of Moscow, will be the guests of the society at these meetings. The former will speak on Thursday afternoon at four P. M. on the subject: "Experimental zoology and the Moscow Institute." The latter will speak at the same time on the following day on: "The theory of nervous activity and the theory of sight."

A symposium on "Morphogenesis" has been arranged for Saturday afternoon in conjunction with the botanists and naturalists. Professors Child, R. S. Lillie, Buller and Harper will speak.

Through an agreement of long standing the arrangement of the zoological aspect of the program of Section F of the American Association rests with the American Society of Zoologists when the two meet together. Zoologists who are not members of the society may have papers placed on the program if sponsored by some member. All titles submitted for the program must be accompanied by an abstract of not more than 250 words and must reach the secretary by November 20. Titles and abstracts on all phases of zoology, evolution included, other than genetics should be sent directly to the secretary. Titles and abstracts in genetics should be sent to Dr. D. F. Jones at the Connecticut Agricultural Station, New Haven, Conn.

The abstracts will be published in the *Anatomical Record* preceding the meeting and reprints will be available for distribution before the meetings convene. Persons desiring these abstracts sent them on publication may order them from the secretary at a cost of thirty cents per copy.

W. C. ALLEE,
Secretary

ZOOLOGICAL BUILDING,
THE UNIVERSITY OF CHICAGO

DEDICATION OF THE STEINHART AQUARIUM

THE Steinhart Aquarium of the California Academy of Sciences was formally dedicated and opened to the public on Saturday afternoon, September 29, 1923.

The exercises were held out doors in the large court in front (north side) of the building which is located in Golden Gate Park, San Francisco, adjoining the museum of the California Academy of Sciences. An audience of more than five thousand was present.

Brief addresses were given by: Honorable C. E. Grunsky, president of the academy; Honorable Wm. H. Crocker, president of the Board of Trustees; Honorable William Sproule, president of the Southern Pacific Railroad Company and member of the Board of Park Commissioners; Honorable James Rolph, Jr., mayor of San Francisco; Dr. David Starr Jordan, chancellor emeritus Stanford University, and Dr. Barton Warren Evermann, director of the Aquarium. Music was furnished by the Park Band. The address given by Dr. Evermann will be published in *The Scientific Monthly*.

The Steinhart Aquarium is proving the most popular attraction in San Francisco, the number of visitors daily reaching more than 25,000.

SCIENTIFIC NOTES AND NEWS

THE degree of doctor of science has been conferred by the University of Wales on Sir Charles Sherrington, president of the Royal Society.

DR. HIDEYO NOGUCHI, of the Rockefeller Institute for Medical Research, has been elected to membership in the Imperial Academy of Japan.

DR. CLIFTON D. HOWE, dean of the faculty of for-

estry of the University of Toronto, has been elected president of the Canadian Forestry Association.

PROFESSOR R. A. SEATON, dean of engineering in the Kansas State Agricultural College, was elected president of the Kansas-Nebraska section of the Society for the Promotion of Engineering Education at the annual meeting held at Lincoln, Nebr., on October 20 and 21.

JOHN HOWE HALL, of the Taylor-Wharton Iron & Steel Company, of High Bridge, N. Y., has been awarded the J. H. Whiting gold medal of the American Foundrymen's Association at its recent meeting, for outstanding achievements in metallurgy.

IN connection with the celebration of the centenary of the birth of Pasteur, the French government has made awards in "La Légion d'honneur" of 2 "grands officiers, 9 "commandeurs," 28 "officiers" and 52 "chevaliers."

MEMBERS of the Pasteur Institute, Paris, were awarded promotions as follows: M. Calmette, "grand officiers, 9 "commandeurs," 28 "officiers" and 52 Radot, "commandeurs"; MM. Fernbach, Fourneau, Marie, Mesnil, Prévot, Tourtel, Dr. Veillon, "officiers." Drs. Abt, A. Berthlot, Besredka, Dumas, Duclaux, Dujaric de la Rivière, Pozerski, Weinberg, MM. Boquet, Danysz, Pontenay-Fontête, Mlle. Ledebt, MM. Ramon, Viala, Agulghon, Cesari, "chevaliers."

DR. ARTHUR S. RHOADS, pathologist of the Missouri State Fruit Experiment Station, has accepted the position of assistant plant pathologist of the Florida Agricultural Experiment Station.

RICHARD FISHER, formerly of the department of chemistry of the University of Illinois, and William B. Plummer, formerly research chemist of the Grasselli Chemical Co., have joined the research staff of the Combustion Utilities Corp., Long Island City, New York.

THE National Lamp Works of General Electric Company in entering upon a policy of general reduction and retrenchment in home office expenses has felt obliged to restrict the scope of its scientific research to problems bearing more immediately upon its chief business interests. In consequence the company has reluctantly decided to discontinue the research work in biology in Nela Research Laboratories, a research section recently established under the direction of Dr. Ralph S. Lillie, with Dr. Samuel E. Pond as associate, and Dr. Marie Hinrichs as research assistant. This decision affects not only the biological work at Cleveland but that which has been conducted during the summer months in the company's laboratory at Woods Hole, Mass.

DR. W. H. PERKIN, of the University of Oxford, engineer and director of research for the British Dyestuffs Corporation, Limited, has been appointed director of research of the corporation to succeed Professor A. G. Green, who recently resigned.

WE learn from *Nature* that Mr. A. Eastham, who has held botanical and seed-testing appointments in Canada, has been appointed to be chief officer of the Official Seed Testing Station for England and Wales.

DR. CHARLES H. HERTY, president of the Synthetic Organic Chemical Manufacturers' Association, has sailed for a short visit to Europe.

OTTO H. SWEZEY, entomologist, and Gerril P. Wilder, botanist, have completed for the present their investigations in Samoa and have returned to Honolulu. In addition to conducting investigations relating to economic problems, collections were made for Bishop Museum.

PROFESSOR R. B. THOMSON, of the University of Toronto, who has been interested in the establishment of botanical gardens in Toronto, has been granted leave of absence by the university until February, that he may visit Australia and New Zealand. Professor Thomson read a paper at the Liverpool meeting of the British Association as a delegate from the Royal Society of Canada.

DR. GEORGE OTIS SMITH, director of the U. S. Geological Survey, addressed the Boston Section of the American Institute of Mining and Metallurgical Engineers on October 16, on "Lessons from the coal commission's work."

DR. H. W. WILEY gave an address in Pittsburgh on the evening of October 26, before the Langley Science Teachers' Association, on the "Relation of nutrition to biology."

PROFESSOR A. BIEDL, of the University of Prague, will give the Harrington Lecture at the University of Buffalo on Saturday, November 10.

PROFESSOR W. D. TREADWELL, of the Technical High School, Zurich, lectured on "Electrometric methods in analytical chemistry" on November 2, under the auspices of the Manchester sections of the Society of Chemical Industry, the Institute of Chemistry, the Society of Dyers and Colorists and the Manchester Literary and Philosophical Society.

DR. H. FREEMAN STECKER, professor of mathematics in the Pennsylvania State College, died on October 30, aged fifty-six years.

DR. BORIS SIDIS, known for work in psychopathology, died at his home in Portsmouth, N. H., on October 25, aged fifty-six years.

PROFESSOR HERBERT MCLEOD, F.R.S., distinguished

as a chemist, physicist and scientific bibliographer, died on October 1, aged eighty-two years.

Dr. John Allen Harker, F.R.S., chief assistant and head of the Thermometry Division of the British National Physical Laboratory, died on October 10, aged fifty-three years.

The Astronomy and Physics Club, of Pasadena, began its third year on October 5, the program for the month is: October 5, "Report on the Liverpool Meeting of the British Association and on the condition of scientific work in Europe," Dr. Paul S. Epstein. October 12, "The Hall-effect and specific resistance of cathodically sputtered films," Dr. Stewart S. Mackeown. October 19, "The Errors of Diffraction Gratings," Dr. John A. Anderson. October 26, "The ruling of diffraction gratings, Dr. John A. Anderson.

Lectures are being given during November at the New York Botanical Garden on Saturdays and Sundays at 3:30 p. m., as follows:

November 3—"Mountain scenery of the United States and Mexico": Mr. Le Roy Jeffers.
" 4—"Rare pines and firs": Mr. K. R. Boynton.
" 10—"Botanical rambles in Panama": Dr. M. A. Howe.
" 11—"The origin of cultivated plants": Dr. A. B. Stout.
" 17—"Ferns": Dr. R. C. Benedict.
" 18—"Java and the Javanese people": Dr. H. A. Gleason.
" 24—"A trip to Ecuador": Dr. F. M. Chapman.
" 25—"British Guiana": Miss Ruth Rose.

It is proposed to establish a Banting Medical Research Foundation, plans for which were announced on October 31, at London, Ontario. Dr. Banting was the first contributor to the proposed $1,000,000 fund, having signified his intention to donate $10,000, a portion of his share of the 1923 Nobel Prize. A committee to take preliminary charge of the foundation and its financing includes John Rogers, of Toronto, chairman; Dr. Stewart, president of the New York Academy of Medicine; Professor Fitzgerald, University of Toronto, and Dr. George W. Ross, of Toronto.

Chemical and Metallurgical Engineering reports that a new chemical and physical research laboratory is planned by the National Tube Company, of Pittsburgh. It will be situated on Forbes Street, adjoining property held by the federal government, including the United States Bureau of Mines. A small tract of government property is needed to square the site for the proposed building, and application has been made at Washington for the transfer of the land.

The editorial office of International Critical Tables has finished the preparation of a table of the viscosity of water at 1° intervals between 0° and 100° C. This table is based upon a thorough and critical evaluation of all the data available on the subject. While prepared primarily for the use of the cooperating experts of the International Critical Tables, a number of extra copies are available. Copies of the sixteen-page pamphlet entitled "Fundamental Constants and Conversion Factors" are also available. This pamphlet contains the latest data on the fundamental constants of nature, including definitions, dimensional equations, conversion factors, etc.

The *Journal* of the American Medical Association states that under the direction of the national public health service and under the auspices of the Spanish Cancer Research Society, an institution has been opened for the study of cancer at Madrid. The clinical section includes twenty-eight beds, with rooms for operations and medical treatment, and a free outpatient service. There is a complete installation for radiotherapy and radiologic diagnosis. The section of anatomy, pathology and bacteriology includes several laboratories, as also the chemical section. The institution is mainly supported by the government, but part of the running expenses is paid by the patients and private donations. Dr. J. Govant is medical director.

The *British Medical Journal* reports that the Advisory Committee on Industrial Hygiene, which has just ended its sittings at the International Labor Office of the League of Nations at Geneva, adopted a resolution stating that the most effective method of securing the success of research into the prevention of anthrax would be the constitution of national committees to work under the general direction of the Health Committee of the League of Nations. Members might be appointed after consultation between the Health Committee of the League of Nations and the government departments in each country which are responsible for the administration of the Factory Acts. Dr. Smyth, assistant professor of industrial hygiene at the University of Pennsylvania, described his method of iodine disinfection to the committee, which expressed the hope that his observations would be followed up. The committee also discussed the possibility of sterilization of the effluents of tanneries.

We learn from *Nature* that an Empire Mining and Metallurgical Congress is to be held at the British Empire Exhibition in London during the first week in June, 1924. The Institution of Mining and Metallurgy, the Institution of Mining Engineers, the Institution of Petroleum Technologists, the Iron and Steel Institute and the Institute of Metals, representing the scientific and technical interests of the mineral and metal industries, with the Mining Association of Great Britain and the National Federation of Iron and Steel

Manufacturers, are cooperating as conveners of the Congress. This is the first such congress to be held, and it is anticipated that succeeding sessions will be held in the Dominions under the auspices of an Empire Council of Mining and Metallurgical Engineering Institutions, which it is hoped will be constituted as a result of the inaugural congress. Viscount Long of Wraxall will deliver the Sir Julius Wernher Memorial Lecture of the Institution of Mining and Metallurgy at the opening session, taking mineral resources and their relation to the prosperity and development of the Empire as his subject. The May Lecture of the Institute of Metals to be delivered by Dr. F. W. Aston, on "Atoms and isotopes," will also form part of the program.

Twenty leaders in the American pulp and paper industry have been asked by Secretary of Agriculture Wallace to form an advisory committee to work with the United States Department of Agriculture in formulating and carrying out its forestry policies which relate to the supply and use of timber in making paper and kindred products. Hugh P. Baker, secretary of the American Pulp and Paper Association, has been active in the formation of the advisory committee and has conferred concerning the matter with Chief Forester Greeley and E. H. Clapp, director of research for the Forest Service. Secretary Wallace states that the creation of an advisory committee composed of men intimately concerned with the pulp and paper industry will, in his opinion, insure thorough consideration of requests for advice as well as bring forth advice itself which would deal in a searching and practical way with the fundamental problems of the industry. Among the activities of the department closely concerned with the pulp and paper industry are the research in pulp and paper-making conducted at the Forest Products Laboratory at Madison, Wis., forest research in the growing of timber crops now under way at the various forest experiment stations, and the development of federal and state policies for the production of timber upon the country's forest lands.

Hitherto the mathematical, physical and biological papers submitted to the Cambridge Philosophical Society have been published in one series of proceedings. In order to facilitate the publication of the results of biological research carried out in Cambridge, it has been decided to attempt the publication of a separate series of *Biological Proceedings*. The new series will consist largely of papers representing the results of completed work, and notices of preliminary investigations will be added as an appendix. The following constitute a committee to whom papers are referred prior to publication: H. R. Dean, F. G. Hopkins, A. C. Seward, J. T. Wilson, J. Barcroft, J. Gray, T. C. Nicholas and F. A. Potts.

UNIVERSITY AND EDUCATIONAL NOTES

Two Atlanta women have left large legacies to Atlanta colleges. Miss Jane Walker Inman left $259,000 to Agnes Scott College to be used in establishing an endowment in honor of her brother. Mrs. Robt. J. Lowry left $275,000 to Ogelthorpe University to establish a school of commerce and banking in honor of her deceased husband, Colonel Robt. J. Lowry.

Edgar Allen, formerly of Washington University, St. Louis, has been appointed professor of anatomy at the University of Missouri.

Frank A. Ferguson, associate professor of physics at Rutgers College, has been appointed head of the department of physics of the Connecticut Agricultural College.

John L. Bray has resigned his position as metallurgist with the U. S. Tariff Commission to accept the professorship in metallurgy at Purdue University.

Dr. Joseph P. Hetwer and Dr. Harry A. Beckman have been appointed instructors of physiology and pharmacology, respectively, in the Marquette Medical School.

Walter C. Kraatz, Ph.D. (Ohio State University, '23), who has been instructor in the department of zoology at Ohio State University, is this year assistant professor and acting head of the department of zoology at Miami University, during the leave of absence of Professor S. R. Williams.

Professor John Read, of the University of Sydney, and Professor Adam Patrick, of the University of Glasgow, were installed in the chairs of chemistry and medicine, respectively, at the University of St. Andrews on October 5.

Dr. James Franck has been appointed to the chair of physics in the University of Berlin, vacant by the death of Dr. Heinrich Rubens.

DISCUSSION AND CORRESPONDENCE

ACTIVE HYDROGEN BY ELECTROLYSIS

In 1907 Fischer and Massenez[1] obtained a concentration of 17 per cent. by weight of ozone when they electrolyzed a solution of sulfuric acid, using a very high current density. Since ozone can be produced by this method, it would seem probable that a high current density at the cathode might aid in the production of the ozone form of hydrogen. When a solution of sulfuric acid is electrolyzed, using the above principle, the hydrogen that escapes at the cathode contains an active constituent which combines with pure nitrogen to form ammonia. Some of the am-

[1] *Z. Anorg. Chem.*, 52, 202 (1907).

monia formed is collected in the absorption bulb, but quite a large portion of it is dissolved by the sulfuric acid solution. This active constituent in the hydrogen that is evolved at the cathode is probably the ozone form, and is produced perhaps in a manner analogous to the ozone form of oxygen. The percentage of the active gas formed varies with the current density and the concentration of the acid.

Likewise, if a solution of potassium hydroxide is electrolyzed using a high cathode current density the escaping hydrogen contains the ozone form which combines with pure nitrogen to form ammonia.

In the electrolysis of the acid solution the escaping hydrogen contains a fog which persists after the gas has passed through the absorbing solution. This fog is similar to, but less dense than, the fog sometimes produced by ozone when it is bubbled through potassium iodide solution.

This work is a further verification of the theory of Dr. G. L. Wendt that triatomic hydrogen may be produced wherever atomic hydrogen is formed.

A. C. Grubb

Department of Chemistry,
University of Saskatchewan

SOLDNER, FOUCAULT AND EINSTEIN

In your issue of August 31, pp. 161–163, you print Dr. Trumpler's defense of Einstein, yet as Trumpler does not touch at all upon one of my leading points, namely, Einstein's ignoring of Foucault's experiment of 1850, which disproved the emission theory of light —my criticism being that Einstein continued to use the emission theory as if it were lawful, whereas it has been outlawed now for 73 years—I will claim only a few lines of your space in order to supply Trumpler's omissions:

1. We do not deem it necessary to reply to Trumpler's labored defense of Einstein; his admissions are sufficiently damaging both to Einstein and to relativity. Soldner's paper bore the title, "Ueber die Ablenkung eines Lichtstrahls von seiner geradlinigen Bewegung durch die Attraktion eines Weltkörpers, an welchem er nahe vorbeigeht"—"On the deviation of a ray of light from its rectilinear motion through the attraction of a heavenly body near which it passes." Let this title speak for itself. I am willing to stand with Dr. P. Lenard, winner of the Nobel Prize in physics, long recognized as one of the leading physicists of our age.

2. Apparently Dr. Trumpler is unable to make a defense of Einstein in ignoring Foucault's celebrated experiment of 1850, showing that the velocity of light is less in water than in air, and therefore light is a *wave motion in the ether,* and is not corpuscular. It seems that Einstein, because he denies the existence of the ether, could not derive Soldner's formula of 1801, without adhering to the hypothesis of emission, that "Light is subject to gravitation." Soldner had a right to use the emission theory in 1801, half a century before Foucault's *experimentum crucis* of 1850; yet in 1911, Einstein was debarred, by every canon of science, from a similar procedure, because Foucault's work 60 years earlier had outlawed the corpuscular theory of light for all time. Thus Einstein's procedure in 1911–16 was wholly unlawful. The *Astronomical Society of France,* in the *Bulletin* for Sept., 1923, will take cognizance of the ignoring of Foucault's celebrated experiment.

T. J. J. See

Mare Island, California

No comment on the following note is required. I might request, however, that after reading it, the reader turn again to my note in the issue of Science for August 31, 1923, pp. 161–163.

Robert Trumpler

Lick Observatory

SIGMA XI

In Science for October 5 I find on pages 259–260 a communication making certain statements regarding Sigma Xi.

It is said that "the policy of the Sigma Xi has been to refuse the granting of chapters to state colleges." This view is incorrect. Neither the convention nor the executive committee has ever directly or indirectly adopted any policy excluding or favoring one class of institutions above another. Both the executive committee and the convention have been very careful to consider every application absolutely on its merits. As a matter of fact at least one state college has been granted a chapter. I am confident that there is no prejudice either in the society in general or among the members of the executive committee against state colleges or any other particular group of institutions.

The other statements made concerning Sigma Xi involve comparisons the justification of which must rest on the judgment of the individual, but there are some who would dissent from other conclusions reached by the author of this communication.

Henry B. Ward,
President

University of Nebraska

MODERN AND CLASSICAL GREEK

Professor Edwin H. Hall has given in Science, Vol. LVIII, No. 1490, pp. 37–39, an eloquent and just tribute to the memory of his colleague and my admired classmate, Arthur Gordon Webster.

Dr. Hall refers in a footnote to Webster's addressing "in their own tongue assemblies of Greeks in Worcester." It should be stated, however, that this was not classical Greek. Webster succeeded where

one of Great Britain's famous prime ministers failed.

It is quite generally known that the Right Honorable Wm. E. Gladstone was an eminent Greek scholar, regarded as an authority in university circles. It is not so generally known that on one occasion he went to Athens to deliver an address in Greek. It was a long speech seemingly full of eloquent and loud-sounding periods. The audience applauded vigorously, but the applause was due to politeness, not comprehension, as those present thought that the orator was speaking English.

Each commencement we behold some vacant-eyed youth crowned with a *summa cum laude* in Greek, and we wonder as we look at him if he should be dropped down in some corner of Greece, whether he could tell the natives his name and where to take him.

ALEXANDER McADIE

QUOTATIONS

MEDICAL RESEARCH IN INDIA

THE committee on retrenchment in India, over which Lord Inchcape presided, recommended, among other things, that the payment of research officers from central revenue should cease, and that the grant-in-aid to the Research Fund Association should be discontinued. The association had accumulated 33 lakhs, derived from the Government contribution and earmarked for a new central institute at Delhi; the committee advised that the interest on this sum should be used for the maintenance of medical research. The *Pioneer*, which is commonly credited with being well informed as to the intentions of the Government of India, stated in its issue of June 7 that it was understood that the Inchcape Committee's recommendations regarding the continuance of expenditure on medical research will not be accepted in their entirety. The adoption of the drastic proposals put forward by Lord Inchcape and his colleagues would, our contemporary continues, have involved "the virtual closing down of all research work in India, for, in the face of such a curtailment of activity, the chances of obtaining research workers in the future would have been small indeed. As it is, there is ground for the belief that the policy to be adopted will be that of securing a state of suspended animation. Thus instead of abolishing the appointments of twelve bacteriological officers, as recommended by the Retrenchment Committee, it is proposed to leave six of these appointments unfilled until financial conditions are more favorable. The establishment of a central research institute at Delhi and the grant of five lakhs a year to the Indian Research Fund Association are similarly suspended. This measure of retrenchment will be regretted, but it, at least, will not render the position hopeless, and it provides the retention of a nucleus for expansion when the occasion is suitable. The Directorship of Medical Research has been abolished for the time being, but arrangements are being made for that officer's duties to be carried on departmentally." The *Pioneer* goes on to express the opinion that if its prognostications prove to be correct, the Government of India has been able "successfully to temper its obsession on the subject of retrenchment with a due appreciation of the vital importance of medical research in a country like India." We can only express a fervent hope that this interpretation of the situation may prove to be correct; it does not seem to be a particularly courageous manner of dealing with a matter of so much importance. As we observed when the Inchcape report was first published, it is a paltry piece of economy to cut down the relatively small sum provided for the scientific study of the causes which lead to the high mortality among the 350 millions of the population of India. The amount represents an expenditure of about one twelfth of a farthing a head a year. The wisdom and policy of establishing a central medical research institute at Delhi is, we admit, open to doubt; it may be very much wiser to subsidize provincial institutes and special inquiries. It is easier to destroy than to build up, and even if a nucleus be retained the loss of experienced workers can hardly fail to make the eventual expansion more difficult.—*British Medical Journal.*

SCIENTIFIC BOOKS

Minéralogie de Madagascar, Vol. I and Vol. II. By A. LACROIX. Paris, Augustus Challamel, editeur, Librairie maritime et coloniale, 1922; Vol. I, 624 pp., 27 plates, one physical map in colors; Vol. II, vii, 694 pp., 29 plates and 11 maps in the text, 4to.

THE "Minéralogie de Madagascar," by Prof. Alfred Lacroix, of which the first and second volumes have appeared, is one of the most comprehensive studies of its kind that has been published, and gives us a wealth of information regarding the mineralogy and petrography of France's great island colony.

The first volume is devoted to the geology of the island, the first chapter giving a general idea of its geography (pp. 1–18). In the second chapter (pp. 19–148) the various geological aspects are described at considerable length under the sub-headings, "Region of Crystalline Schists" (pp. 19–51); "Sedimentary Formations" (pp. 52–56); "Intrusions and Post-liasic developments," "Recent Volcanoes" (pp. 77–150). This is followed by a section devoted to the mineralogy of the island (pp. 151–604).

The second volume treats of applied mineralogy, mining, etc. (pp. 1–218), of lithology (pp. 219–576).

The writer begins by noting that, after New Guinea and Borneo, Madagascar is the largest island of the

globe. It has an extreme length of 1580 kilometers (nearly 953 miles) and an extreme width of 580 kilometers (about 360 miles). Its area exceeds 600,000 square kilometers (231,660 square miles), while the area of France is but 212,659 square miles. The island was visited by the Arab travelers at an early date, and was known to Marco Polo, who wrote towards the end of the thirteenth century; he is said to be the first European or Asiatic author to use the name "Madagascar." Geologically, this vast area contains (1) a region essentially formed of the crystalline schists and eruptive intrusive rocks; (2) a region of sedimentary or volcanic rocks; (3) a small, but interesting zone, forming the eastern side of a narrow border of sediments and sand dunes. The crystalline massif, essentially mountainous, extends for nearly the entire length of the island.

Of the gems of Madagascar, the author notes that from its discovery the island was reputed to furnish gems, and in 1542 Jean Fonteneau, the second Frenchman to land there, declared that precious stones were to be found, while in 1658 Flacourt speaks of topazes, aquamarines, emeralds, rubies and sapphires, of course from hearsay. However, the mineralogist, Alfred Grandidier, who explored the island extensively in 1870, stated that the Madagascans had no idea of what a precious stone was, and that they only cared for colored glass beads. Indeed, Professor Lacroix says that the actual discovery of gem material hardly dates farther back than thirty years. In 1891, M. Grandidier gave the Muséum d'Histoire Naturelle in Paris some fine crystals of rubellite and a few small sapphires and zircons.

As a result of several years of exploitation, it can be said that the beryls are the finest of the Madagascar gems, and they now constitute the chief part of the precious stone product. Many fine blue beryls have been found, but the choicest are unquestionably the cesium beryls of a peach-blossom pink hue, the type on which the writer of the present notice has bestowed the name "morganite." These and other of the beryls of greatest density are found in the sodolithic pegmatites, and since the deposits of Maharitra have become exhausted, the beryls now in commerce come principally from the eluvions of Anjanabonoina. In the British Museum there is a splendid cut beryl from Madagascar, weighing 600 carats, with a density of 2.835, and the American Museum of Natural History in New York owns a magnificent cut example of the morganite type, weighing 57½ carats, the density being 2.827. Professor Lacroix believes that both of these came from Anjanabonoina. He also believes that he was the first to have Madagascar stones cut, at the time the products of the island were exhibited in the Muséum d'Histoire Naturelle. These gems were chrysoberyls, garnets, corundums and topazes. Tourmalines occur in great variety (Vol. I, pp. 411–442; Vol. II, pp. 92–95) and of many beautiful hues, the red variety (rubellite) being the most precious. Specimens from Antandrokomby, Ampantsikahitra and other localities have furnished fine gems. Those of a golden yellow or a lemon-yellow are among the most characteristic; these are found principally in Tsilaizina. A number of exceptionally fine examples of lithia tourmalines are shown on Plate 9, Vol. II. The long list of Madagascar gem stones includes the following: beryl, tourmaline, both in a great variety of colors, kunzite, garnet, spinal, chrysoberyl, zircon, cordierite, diopside, amethyst, smoky-quartz and rock-crystal, opal and also kornerupine, danburite, scapolite and a beautiful ferriferous orthoclase.

Rock-crystal in remarkably fine specimens, rivalling those from any other source, have been found in Madagascar, which have been splendidly utilized in the ornamental arts. Fine examples of these crystals have been figured in Vol. I, plates 5 and 6. Large crystals have been utilized for several centuries for art objects and ornaments, and many of the artistic cups in our museums have been made from rock-crystal of Madagascar, which rivals that from Brazil in this respect. It is also employed for spheres, seals, boxes, perfume phials and for the pendants of chandeliers (Vol. II, p. 112).

The upright stones, called *vatomitsangana* (literally "standing-stone"), or *vatolshy* ("male-stones") in the Androy district of Madagascar (Vol. II, p. 169, Plate 18, opp. p. 166), are granite or gneissic monoliths erected in memory of a relative whose remains do not rest in the tomb of his ancestors. They are sometimes used as altars before which the natives offer prayer, and they anoint the sides of the stones with grease and place quartz pebbles on the summit. In size they vary from an average of two meters (6½ feet) to five meters (nearly 17 feet) in height, with a width of 50 or 60 centimeters (20 to 24 inches) and a thickness of from 25 to 30 centimeters (10 to 12 inches).

Danburite has been found in the pegmatites of Maharitra and in the eluvions of Imalo, in crystals sufficiently transparent to warrant cutting. They make a gem of madeira-yellow of various intensities, possessing properties closely similar to those of the topaz. Professor Lacroix believes some of them have been already sold under that name; he secured from Maharitra a stone weighing over five carats, and in a lot of minerals from Anjanabonoina he came across two fragments of danburite of a magnificent golden-yellow. One of these has been cut and furnished a gem weighing about 13 carats (Vol. II, p. 103).

The ferriferous orthoclase of Madagascar is sometimes of a magnificent golden yellow and occurs in crystals weighing up to 100 grains; it furnishes cut

stones of several grams, which make a very fine effect. The low degree of hardness does not permit the use of these for jewels in constant use, but nevertheless the stone can be utilized by jewelers. Perfectly clear crystals of fine color have sold for from 75 to 500 francs the kilogram (Vol. II, pp. 102, 103).

The transparent variety of kornerupine (prismatine) was found among some minerals gathered twenty kilometers east of Itrongay. It was in clear, isolated fragments of a deep olive-green, some of them four centimeters long, and was probably derived from a pegmatite rather than a gneiss. They furnish very beautiful cut stones. The polychroism is evident beneath a certain depth, and the tint varies a little according to the direction given to the table. The largest of several weighed 21 carats. The smallest stones, of a clear green, recall certain varieties of beryl and tourmaline (Vol. I, page 396; Vol. II, p. 102).

Professor Lacroix notes that among the cut tourmalines from Madagascar he has remarked the following colors (Vol. II, pp. 93, 94):

Red (rubellite): Magnificent stones varying from blood-red to vinous-red, sometimes with a violet tinge. Certain of them resemble rubies at Antandrokomby, etc.

Pink: Numerous varieties more or less pale; especially vinous-pink, salmon-pink, peach-blow color, recalling the tint of the beryls from the same region and also the burnt topaz. These are the predominant types at Maharitra.

Amethyst violet: At Anjanabonoina.

Golden-yellow to orange: These are the richest in manganese and the densest and most characteristic of Madagascar. Found, above all, at Tsilaizina.

Brown: Dark brown at Tsilaizina; coffee-colored and warm-browns at Anjanabonoina.

Grayish-brown, or smoky: Maharitra, Anjanabonoina.

Olive-green: Only furnish stones of inferior value. Maharitra, Anjanabonoina; much resemble the Brazilian.

Pale green: At Vohitrakanga, a variety, the olive hue of which recalls that of korneropine and some beryls.

Grass-green: A great range of shades, especially apple-green and grass-green, recalling some of the tourmalines from Maine. At Anjanabonoina, Maharitra. At Ankitsikitsika are some crystals half green and half red.

Blue: The indicolite variety is the most frequent. Maharitra. When very dark blue they have little commercial value.

Colorless: Madagascar furnishes probably the greatest number of fine, clear, colorless tourmalines, but they are rare. Maharitra, Anjanabonoina.

The statistics from 1897 to 1921 show that Madagascar yielded quite an amount of gold in that period, the total production being 42,129.95 kilos (1,354,579 ounces). For the past ten years or more there has been a steady falling off, from a maximum of 3,696.87 kilos (118,858 ounces) in 1909 to only 456.24 kilos (14,668 ounces) in 1921. The total value of this gold product was $27,989,147 for the twenty-five years, an average of over a million per year.

Graphite in considerable quantity has been mined on the island (Vol. II, pp. 148–155), and the exports have been quite important. The deposits occur in a great many localities; indeed, wherever there are gneisses, more or less graphite is to be found. The amount obtained varied much in the several years, reaching a maximum of 35,000 tons in 1917 and falling to about 4,000 tons in 1920. In 1917 the material brought 1,200 francs a ton in Marseilles.

Of the uraniferous minerals from which radium can be extracted, Madagascar furnishes a number (Vol. II, p. 132), for example, fergusonite, euxenite, samarskite, blomstrandite and three minerals special to the island, namely, betafite, samiresite and ampangabeite. There are also deposits of autonite and uranocircite. Of these the minerals which are economically important are betafite and euxenite, the former being much the most exploited; the largest deposit is that of Ambatofotsy (Vol. I, p. 386). Certain of these betafites have been worth as much as 15,000 francs a metric ton. These ores are sometimes sold according to the radium content, the unity being one milligram per ton, the value of this unit ranging from 100 to 200 francs.

The fourth section of the work is devoted to the lithology (or petrography) of the island, and Professor Lacroix states that the classification used is that which he has set forth during the past few years in his lectures at the Muséum d'Histoire Naturelle. He briefly summarizes it as follows:

The eruptive rocks are considered, not only from the viewpoint of their mineralogical composition and their structure, as in the classification of Fouqué and Michel-Levy, but account is taken of the relative quantities of their constituent minerals, and also of their chemical composition, this latter point being especially considered in the present work.

The rocks are divided into five great classes, based upon the nature of their white minerals (quartz, feldspars, feldspathoides). The first two comprise the rocks rich in quartz; the third class those rocks whose essential white elements are feldspars; the fourth is constituted by rocks in which the feldspars are accompanied by a notable quantity of feldspathoids (nephelines, leucities), and, finally, the fifth class is reserved to the little group in which the sole white element is a feldspathoid. These divisions correspond to very important chemical properties, the excess of silica above the quantity necessary to enable the aluminum, joined with the requisite quantity of oxides, to form feldspars in the first two groups; the complete or approximate saturation of this silica in the third group, and its lack in the last two classes.

A very interesting part of the section "Lithology" is that devoted to comparison of the sodo-lithic peg-

matites of Madagascar with those of other countries (Vol. II, pp. 334–362). This embraces a careful description of these pegmatites in New England and in California, the greater part of the deposits having been studied in 1888 and in 1913 (pp. 334–346); in the last-named year Professor Lacroix was actively engaged in completing the great collection of American gems so generously donated to the Muséum d'Histoire Naturelle in Paris by J. Pierpont Morgan. He was accompanied on several of his excursions by the writer of the present notice and by Mr. Howe. He notes the striking resemblances between the pegmatites of California and those of Madagascar, the association in both regions of lithia tourmalines, notably of rubellite, caesium beryls, kunzite and spessartite, and the existence of native bismuth, of maganocolumbite. On the other hand, mineralogical differences must be noted.

The special attention here given by Professor Lacroix to these analogous formations in the United States is well worthy of remark in view of the fact that in but too many mineralogical handbooks composed by Europeans rather scant notice is taken of the United States.

Within the restricted limits of the present review we can only indicate the chief divisions of the section Lithography in Volume II, as follows:

First Division, Intrusive Rocks

Chap. I. Quartzite Rocks, pp. 229–243.
Chap. II. Pegmatites, pp. 244–376.
Chap. III. Syenites and Nephelinic Syenites, pp. 377–397.
Chap. IV. Rocks with Plagioclase, pp. 398–438.
Chap. V. Deformations and Transformations of the Eruptive Rocks, pp. 439–455.
Chap. VI. Contact Phenomena of the Eruptive Rocks, pp. 456–472.

Second Division, Crystalline Schists

Chap. I. Gneisses and Micaschists, pp. 479–522.
Chap. II. Quartzites, pp. 523–539.
Chap. III. Essentially Magnesian Rocks, pp. 540–545.
Chap. IV. Essentially Calcareous Rocks, pp. 546–574.
Chap. V. Exclusively Ferriferous or Aluminous Rocks, pp. 575–578.

Third Division, Intrusive Post-Liassic Rocks

Chap. I. Quartzite Rocks, pp. 579–604.
Chap. II. Syenites and Nephelinic Syenites, pp. 605–622.
Chap. III. Syenito-Theralitic Series, pp. 623–643.
Chap. IV. Rocks with Feldspathoids without Feldspar, pp. 643–648.
Chap. V. Plagioclasites, pp. 649–655.
Chap. VI. Contact Phenomena of the Intrusive Post-Liassic Rocks, pp. 656–666.

The third and concluding volume[1] of Professor Lacroix's great work has been received since the review of the first two volumes was in type. This comprises the following petrographic sections: Post-liassic Volcanic Rocks (pp. 2–66); Sedimentary Rocks (pp. 67–91); Alteration of Rocks (pp. 92–149); Sketch of the Leading Lithological Characteristics of the Island (pp. 151–224). This is succeeded by a division devoted to a comparison of certain eruptive regions with those of Madagascar (pp. 227–294), and in the following brief section (pp. 295–334) the writer has grouped, in alphabetical arrangement and as an appendix, a series of mineralogical items which did not reach him until the earlier volumes were in press. The volume then concludes with a Bibliography (pp. 335–349), and an extensive Geographical Index of about 70 pages, succeeded by a Geological, Lithological and Mineralogical Index (pp. 421–431) and 4 pages of Errata. This truly monumental work is destined to remain an authority for a very long time.

George F. Kunz

New York

SPECIAL ARTICLES

THE GENESIS OF NORMAL AND ABNORMAL CARDIAC RHYTHM

The story of the development of the modern ideas concerning the cause of the heart beat constitutes an interesting chapter in medical history. Haller,[1] in 1757, was apparently the first to conceive that the rhythm of the heart was dependent upon the blood flowing through it. To quote:

> Qui hos experimentorum nostrorum eventus pensitaverit, is quidem non dubitabit nobiscum pronunciare, causam quae cor in motum ciet, omnino sanguinem venosum esse. Nam enata ea causa cor movetur, subtracta quiescit, diminuta motus cordis languet, aucta motus intenditur.
>
> Id si verum est, si porro cordis admotum major, quam aliorum musculorum, promtitudo est, si praeterea cordi perpetuus, dum vivimus sanguis advenit, non mirum est, perpetuum cordis motum esse.

Subsequently, in the early nineteenth century, arose the argument as to the neurogenic or myogenic origin of the beat with the evidence then considered to be in favor of the former. The work of Gaskell,[2] in 1881–83, cleared much of the confusion and laid the foundation for subsequent work by pointing out the control

[1] Tome III. Lithologie, Appendice-Index Geographique; Paris, 1923, 437 pp.; 28 text figures, 8 plates, and a colored geological map, 4to.

[1] Haller, Elementa Physiologiae Corporis Humani., 1757, tome I, p. 493.

[2] Gaskell, *Journ. Physiol.*, 1883, *4*, 43.

of the rhythm by the "pacemaking" venous end of the heart. At about the same time Langendorff[3] pronounced the theory that the tissue found its stimulus in the products of its own metabolism, and this view was later adopted by Englemann.[4] Ringer,[5] in 1883, perfused the isolated heart with artificial inorganic solutions and with his work there began extensive researches along this line.

An adequate review is not within the scope of this note. Through the work of many observers the cardiac muscle has come to be regarded as an irritable, conducting, contractile tissue mass which normally responds rhythmically to a so-called "inner stimulus." These fundamental properties, and the "inner stimulus" as well, have been shown to depend upon the composition of the fluid bathing the muscle tissue. Particular importance has been attached to the chlorides of sodium, calcium and potassium. More recently the significance of the reaction of this fluid has been pointed out.

For several years we have been interested in developing an approach to the problem of the cardiac arrhythmias by way of the origin of the normal rhythm. We have studied the isolated, perfused hearts of cold-blooded animals and of dogs. These observations, together with a review of the literature, have led us to advance a conception of the genesis of the heart beat which seems to explain the normal rhythm as well as many of the irregularities. The theory is not entirely a new one. It consists, in part, of the application to the excitatory process in the heart muscle of the results of the study of this phenomenon in other irritable tissues.

Simply stated, our conception is as follows:

The cardiac rhythm is due to the rhythmic building up and discharge of a potential difference across a semi-permeable membrane. The rate of development and magnitude of this potential difference are dependent fundamentally upon the difference in hydrogen ion concentration within the cells of the cardiac tissue and in the fluid bathing them. The level of potential difference at which discharge takes place is determined by the permeability of the interposed membrane. This, in turn, is dependent upon the concentration of sodium, calcium and potassium salts an either side of that membrane.

The muscle cell is essentially made up of an aqueous solution of colloids, certain organic compounds and electrolytes. It is surrounded by tissue fluid of a similar composition but differing from it in the concentration of certain ions. Thus, the muscle cell contains more potassium and less sodium and calcium than the tissue fluid. The concentration of hydrogen ion appears to be greater within the muscle cell than without. This ion is being constantly set free in the cell metabolism. On the other hand, the reaction of the tissue fluid is more rigidly fixed by "buffer" salts.

At the interface between two such phases such substances from each as lower surface energy tend to concentrate. Hence colloids, proteins and lipoids form a surface film which comes to assume definite characteristics as the cell membrane. Space does not permit a detailed description of this membrane, but the studies of Loeb,[6] Osterhout[7] and others assign to it special properties of permeability. It seems established that the membrane is impermeable to colloids. As regards crystalloids the situation is complicated by the presence of compounds of electrolytes and colloids. In addition, the properties of the membrane are such that a more or less constant difference is maintained in the concentration of the inorganic ions within and without the cell. Moreover, the degree and type of semi-permeability appear to vary with the cell and to depend upon the concentration of sodium, calcium and potassium salts in the immediate vicinity.

Since the ionic concentration is not the same within and without the muscle cell a definite potential difference develops across the surface film in accordance with the formula:

$$E = \frac{RT}{F} \cdot LN \cdot \frac{C}{C_1}$$

where C_2 and C_1 represent the concentration of the diffusible ion in the more concentrated and the more dilute phases, respectively. The cell membrane is thus polarized with the outer surface positively charged. Inasmuch as the hydrogen ion is by far the most rapidly moving ion concerned and experimental evidence shows that the polarization of the membrane is not due to the other cations it is to be inferred that the degree of potential difference existing across the surface film is dependent upon the difference in the hydrogen ion concentration in the muscle cell and in the fluid bathing it.

In 1911 Lillie[8] elaborated the "membrane theory" in explanation of the excitatory process in nerve. This theory, originally suggested by Hermann* and Brunings,† has since been shown to be in accord with the experimental evidence in this regard not only in nerve but in other irritable tissues as well. It may reasonably be applied to cardiac muscle. According

[3] Langendorff, *Arch. f. Anat. & Physiol.*, 1884 (supp. vol.), p. 1.

[4] Englemann, *Arch. f. d. ges. Physiol.*, 1897, *65*, 109.

[5] Ringer, *Journ. Physiol.*, 1880–82, *3*, 380.

[6] Loeb, J., *Journ. Gen. Physiol.*, 1922, *5*, 225.

[7] Osterhout, *Journ. Gen. Physiol.*, 1922, *5*, 220.

[8] Lillie, R. S., *Am. J. Physiol.*, 1911, *28*, 197.

* Hermann, L., Handbuch der Physiol., 1879, II, 194.

† Brunings, W., Arch. f. d. ges. Physiol., 1903, C, 367.

to the "membrane theory," the process of excitation involves changes in the permeability of the cell membrane at the point of stimulation and simultaneous depolarization. Since the remainder of the cell surface is positively charged, a current will at once begin to flow towards the stimulated area; this point becomes electronegative to the rest of the cell surface. This constitutes the action current and its strength depends, obviously, upon the potential difference existing across the membrane at the time of stimulation.

Nernst,[9] considering the effect of electrical stimuli, brought forward the view that stimulation involved a critical increase in concentration of ions on either side of a semi-permeable membrane. In other words, if a certain potential difference were developed across a membrane in a certain time that very potential difference would cause changes in the membrane which would constitute stimulation. Upon this conception he showed that any current to stimulate must fulfill certain relations of intensity and duration, as expressed in the formula:

$$I\sqrt{T} = c$$

where I represents intensity and T duration of current, and c denotes the threshold of the tissue involved. With minor modifications this relation has been shown by Lucas[10] to hold over a wide range of tissues. Lapicque[11] has shown that this formula applies to the polarization of artificial membranes as well.

Lillie has developed the conception that the process of conduction depends upon the excitation of the adjacent area by the action current developed at the point of stimulation. The action current from each excited point causes excitation in its neighborhood and the process is thus propagated in a wave over the tissue. The distance over which the action current can fulfill the requirements of Nernst's formula and so produce stimulation is determined by the potential difference existing at the point of stimulation and by the permeability of the cell membrane. Both of these circumstances are dependent, as we have outlined, upon the relative ionic concentration within and without the cell.

The heart is made up of a mass of tissue similar in composition to the muscle cell described. It is our conception that, under optimum conditions, the difference in hydrogen ion concentration within this muscle mass and in the tissue fluid bathing it, and the proportion of sodium, calcium and potassium are such that a potential difference is built up at a characteristic rate. When this potential difference has reached a certain level changes are thereby produced in the cell membrane which allow a transfer of electricity and stimulation. Once so initiated the excitatory process is propagated over the heart as described above, the action current from each excited point stimulating adjacent areas. It is this wave of negative potential difference which is registered as the electrocardiogram. A most important corollary to such a conception is this: No fiber of cardiac tissue can conduct the excitatory process unless it is itself excited.

Abnormalities of rhythm may thus be due to either or both of two derangements in this scheme: (1) To a change in the development of the excitatory process, (2) to a variation in the mechanism of its conduction, or (3) to a combination of these conditions.

First to consider derangements of impulse formation. Lewis[12] has pointed out quantitative differences in function of the four types of cardiac tissue, nodal, auricular and ventricular muscle, and Purkinje fibers corresponding to differences in structure. These tissues may be regarded as differing in the properties of their limiting membranes and hence in the rate of development of potential difference and in the level at which discharge takes place. Each type of tissue possesses an inherent rhythm. Normally, as Gaskell conceived, the rhythm of the sino-auricular node is most rapid and hence governs the rhythm of the heart. It has been shown that if the sino-auricular rhythm is eliminated some lower rhythmic center takes over control. In terms of our theory the condition of the cell membrane is such in the node that a potential difference is there built up more rapidly, or that discharge takes place at a lower level. Conversely, the same takes place at a relatively much higher level in the ventricular muscle and the inherent rhythm of the ventricle is much slower.

Alteration in the process of impulse formation may be produced either by alteration in the permeability of the interposed cell membrane through a change in the relative concentration of sodium, calcium or potassium, or by a change in the potential difference across the membrane. Our studies have recently been confined to alterations in the hydrogen ion concentration.

It is apparent that as the hydrogen ion concentration of the perfusate is increased the amount of the diffusible ion in the more dilute phase is raised. In other words, the potential difference across the cell membrane is diminished. Theoretically, such a reduced potential difference requires longer to effect stimulation. A priori, therefore, an increase in the hydrogen ion concentration of the fluid bathing the cardic tissue should slow the rhythm of the islolated

[9] Nernst, *Ztschr. f. Elektrochem.*, 1904, p. 665.

[10] Lucas, K., *Journ. Physiol.*, 1908, *37*, 459.

[11] Lapicque, *Compt. rend. d. l. Soc. d. Biol.*, 1907, *63*, 37.

[12] Lewis, *Quart. Journ. Med.*, 1921, *14*, 339.

heart; and it does so consistently. Conversely, an increase in alkalinity, by increasing the potential difference across the cell membrane, should cause a more rapid rate. All our records show that this is also the case.

With the heart in situ the vagus and accelerator nerves may be considered as operating upon the permeability of the cell membrane. The vagus, by decreasing permeability, slows the rate while the accelerator increases the rate of discharge by increasing the permeability. In this connection the work of Howell[13] showing the allied effects of the vagus and potassium is significant.

In experiments with the perfused heart it is possible to control only the hydrogen ion concentration in the fluid bathing the tissue of the heart as a whole. In pathological conditions, however, many other possibilities arise as regard an increase in the hydrogen ion concentration within the cell. The heart is a unique organ in that it is dependent upon itself for its own circulation. The conception is not a new one that with cardiac failure the myocardium suffers for want of a sufficient circulation. Under such circumstances, or even in the absence of clinical evidence of failure of the systemic circulation, local areas of deficiency in the intrinsic myocardial blood supply may conceivably arise. Such local failure of circulation must result in insufficient oxygen supply for the proper oxidation of the lactic acid formed in that area, in short, in a local increase in the hydrogen ion concentration within the tissue. The conditions are thus fulfilled for the development and discharge of a potential difference locally, for the genesis of a so-called ectopic focus of rhythm. The duration and rate of the development of the excitatory process in this focus are determined by the degree of local oxygen deficiency and by the condition of the cardiac tissue as a whole. A minor disturbance may give rise to arrhythmic or rhythmic extrasystoles which may or may not interrupt the dominant rhythm. A more severe change may produce a paroxysm of rapid excitations which may for a time command the rhythm of the whole heart, as illustrated by the onset of ventricular tachycardia following ligation of a coronary artery.

Secondly, arrhythmias may be due to variations in the process of the propagation of the excitation wave. As we have pointed out, according to the "membrane" theory, the rate of propagation of the excitatory process is determined by the area over which the local action current is effective in producing stimulation. Furthermore, this distance is dependent upon the magnitude of the potential difference and the permeability of the membrane. An increase in the hydrogen ion concentration without the cell results in a diminution in the potential difference across the cell membrane and hence a reduction in the intensity of the action current. Such a condition must reduce in extent the area over which the action current from any excited point can produce stimulation. Thus, such a change in the perfusate should slow the rate of propagation of the excitatory process.

Experimental evidence is entirely in harmony with this conception. The prolongation of conduction time in hearts perfused with acid perfusates has been noted by many observers. We have many records to show this. Heart block has been produced in animals by asphyxia and with narcotics. Clinically it is not unusual, in cases of heart failure, to meet with evidence of delayed conduction which disappears with the return of more normal circulation or upon the administration of oxygen.

Finally, more complex abnormalities of rhythm may involve changes both in the development of the excitatory process and in its propagation. If we suppose a local circulatory change giving rise to an ectopic focus of impulse formation, and, in addition, diffuse or local changes in conduction we have those conditions which, through the work of Mines[14] and of Garrey,[15] have been shown to be at the basis of the circus movement involved in flutter and fibrillation.

To summarize briefly: We have outlined a conception of the genesis of the cardiac rhythm as based upon the rhythmic development and discharge of potential difference across a semi-permeable cell membrane. We have described this potential difference as due to the difference in the hydrogen ion concentration within and without the cell, and its discharge as regulated by sodium, calcium and potassium through their effect upon the cell membrane. We have pointed out that local areas of circulatory deficiency in the myocardium may give rise to ectopic foci of impulse formation, and that diffuse changes in conduction may result from an increase in the hydrogen ion concentration of the perfusate. That gaps exist in the chain of evidence we are well aware. We hope, however, that we may have shown it possible to consider the cardiac arrhythmias as no more mystical than the normal rhythm and to offer an explanation common to both.

This communication is in the nature of a preliminary note. A complete account of our work will appear in an early publication elsewhere.

E. Cowles Andrus
Edward P. Carter
Cardiographic Laboratory of the Johns Hopkins University and Hospital

13 Howell, *Am. J. Physiol.*, 1905–6, *15*, 280.

14 Mines, *Journ. Physiol.*, 1913, *46*, 349.

15 Garrey, *Am. J. Physiol.*, 1914, *33*, 397.

AMERICAN MATHEMATICAL SOCIETY

THE thirtieth summer meeting of the American Mathematical Society was held at Vassar College, Poughkeepsie, New York, Thursday and Friday, September 6–7, 1923, in conjunction with the meeting of the Mathematical Association of America. The college contributed greatly to the success of the meetings by opening its buildings for the entertainment of the visitors.

A joint session of the two societies was held on Thursday afternoon, at which the following papers were read:

I. *An introductory account of the arithmetical theory of algebraic numbers and its recent development*, by Professor L. J. Mordell, of the University of Manchester. (Address presented at the request of the American Mathematical Society.)

II. *Mathematicians and music*, by Professor R. C. Archibald. (Address of the retiring president of the Mathematical Association of America.)

At the joint dinner on Thursday evening, President McCracken, of Vassar College, spoke on the relation of the undergraduate college to research. At the close of the meeting, it was voted to express the thanks of the Society to Vassar College for its hospitality.

The attendance included seventy-nine members of the Society. The secretary announced the election of twenty-seven persons to membership, and the entrance of two additional members of the London Mathematical Society under the reciprocity agreement. Forty-nine applications for membership were received.

At the meeting of the council, a resolution was adopted sanctioning the establishment of a lectureship to be known as the Josiah Willard Gibbs Lectureship, to deal in semi-popular form with some aspect of mathematics or its applications. A committee was appointed to make arrangements for the first lecture, which will probably be given in New York City during the winter of 1923–24.

It was voted that in view of the anticipated meeting of the International Mathematical Congress in Canada in the summer of 1924 the society omit a summer meeting for that year.

At the joint meeting of the society and the association, it was voted to request the secretaries of the two organizations to send a letter to the Physico-Mathematical Society of Japan expressing the sympathy of American mathematicians for their colleagues in Japan under the calamity that has befallen their country through the great earthquake.

The following papers were read at the regular sessions:

Note on five points and a cyclic correspondence: H. S. WHITE.

A generalization of the syllogism: B. A. BERNSTEIN.

Operations with respect to which the elements of a boolean algebra form a group: B. A. BERNSTEIN.

A new type of criteria for the first case of Fermat's last theorem: H. S. VANDIVER.

A method for finding a factor of an integer of the form $8n+1$: H. S. VANDIVER.

The distribution of primes and the finiteness of the number of discriminants with a given number of classes: G. Y. RAINICH.

A complete system of differential parameters of orders < 3 *of the binary differential cubic:* O. E. GLENN.

Analytic and non-analytic functions in three dimensions: E. R. HEDRICK and LOUIS INGOLD.

A connected and regular point set which contains no arc: R. L. MOORE.

Concerning the sum of a countable infinity of continua in the plane: R. L. MOORE.

A continuum considered as the sum of its prime elements: R. L. MOORE.

The brachistochrone with variable end points: M. E. SINCLAIR.

A new necessary condition for relative extrema in quadratic and hermitian forms: R. G. D. RICHARDSON.

On the summation of trigonometric series by Euler's method: C. N. MOORE.

Concerning a suggested and discarded generalization of the Weierstrass factorization theorem: L. L. DINES.

A theorem on the factorization of polynomials of a certain type: L. L. DINES.

The scientific work of A. M. Liapounoff: DONAT KAZARINOFF.

The quadratic variation of a function: NORBERT WIENER.

Certain orbits with arbitrary masses in the problem of three bodies: F. H. MURRAY.

Applicability with preservation of both curvatures: W. C. GRAUSTEIN.

Isometric W-surfaces: W. C. GRAUSTEIN.

A new kind of representation of curved space: G. Y. RAINICH.

On two circles: NATHAN ALTSHILLER-COURT.

A minimum problem in elementary geometry: F. D. MURNAGHAN.

A generalization of evolutes: J. L. WALSH.

Congruences of circles studied with reference to the surface of centers: J. M. THOMAS.

A theorem in relativity: JOHN EIESLAND.

On a generalization of Kummer's surface in odd n-space: JOHN EIESLAND.

A note on chapter 2 of volume 3 of L. E. Dickson's History of the Theory of Numbers: JOHN MCDONNELL.

Integro-differential invariants of one-parameter groups of Volterra transformations: A. D. MICHAL.

The dynamics of monopoly: G. C. EVANS.

R. G. D. RICHARDSON,
Secretary

SCIENCE NEWS

WATER FROM BURNT GASOLINE IN AIRSHIPS

Science Service

THE cruising radius of airships, such as the great navy dirigible *Shenandoah*, will be greatly increased as a result of an invention now approaching completion as the result of months of study by the government's aeronautical and scientific experts. The device makes it possible for the ship to burn up its store of gasoline without loss of weight and without increase of buoyancy. This will result in the saving of many thousands of dollars worth of the expensive helium gas that lifts the ship and which otherwise would have to be released and wasted in the air to keep it from rising to dangerous heights.

The principle employed is simple. It involves the condensation of the water vapor resulting from the burning of the gasoline, and the retaining of it in the craft as ballast.

Gasoline is composed of carbon and hydrogen. When burned, the products are carbon dioxide, carbon monoxide and water vapor. The first two gases escape. The last is condensed. Since gasoline requires more than three times its weight of oxygen for complete combustion and since about a third of that goes to form water, the weight of the condensed water is somewhat greater than that of the original gasoline.

This keeps the weight of the airship constant and makes unnecessary a loss of the lifting gas, which heretofore has been a feature of long flights. In an airship without the condensing device, the craft grows lighter as the voyage progresses owing to the consumption of the liquid fuel. This results in the airship rising higher and higher until in the interest of safety some of the buoyant gas has to be liberated. This reduces the reserve buoyancy if unfavorable conditions are met, and so curtails the length of flights.

Airships of the future equipped with the compensating water condensation device will be able to carry up fuel in quantity only limited by the buoyancy of the craft and the requirements of space, and will be able to burn it without releasing a compensating quantity of the precious helium gas.

Water condensation apparatus will be installed on the *Shenandoah*, formerly the ZR-1, before long flights through the polar regions or elsewhere are attempted, according to present plans of the government experts. If the airship of commercial type, the ZR-3, which is now being built for the United States by the German government, is successfully delivered to this country, it also will be equipped with the new invention.

VAPORIZED METAL

Science Service

BRONZE covered statues, copper-covered shingles, concrete piles, or railroad ties, and gold covered furniture are some of the possibilities ensuing from a process for spraying metals, which after years of study is approaching perfection at the U. S. Bureau of Standards. An exhibit showing stone, cement, metal, wood and glass which had been coated by the new process attracted wide attention when shown by the Bureau in the recent Chemical Industries Exhibition in New York.

The essential of the process is that the metal is first vaporized and then sprayed on to the surface to be coated by means of a powerful blast which congeals it to the solid form as quickly as it strikes the surface. Details of the process are withheld by the bureau at present for military reasons, except for the statement that it is based on a new principle and that electricity is used in the vaporization process.

Applications of the method, which results in a firm coating of metal upon any surface to which it is applied, are many and varied. Stone, wood, metal and glass are all equally suitable basic surfaces. Pottery may be successfully coated with metal, pointing to important developments in the ceramic industries.

An important application is in the use of the metal coating in building construction. Shingles may be made fire resisting by coating them with copper, which weathers well and produces an artistic green color on the roof. Experiments are already being made along the lines of copper coating other roofing material and stucco.

Soldering of metal to glass, a difficult problem, has been easily accomplished by means of this method. The glass is first coated with a layer of copper and the metal connection is then soldered to the copper. Processes somewhat similar are used in the soldering of aluminum.

The preservative qualities of metal-coated articles are attracting attention from many quarters. It may be used in airships, and is being experimented with as a marine paint for naval vessels, certain alloys being highly resistant to salt water corrosion and inhospitable to the growth of barnacles. For the same reason it may be used to protect piling and its preservative action may also be used to conserve railroad ties.

On the decorative side the uses of the method are many. Statues or other sculptured designs may be hewn from soft and easily worked stone and then coated with bronze, giving the effect of a bronze statue and weathering equally well. Gold plating or decoration may be applied in the same way to furniture or table ware.

A coating of copper one thousandth of an inch in thickness may, so its inventors say, be applied at the rate of two square feet a minute and at a cost of two cents a square foot exclusive of the cost of labor. Cheaper and more easily fusible metals such as lead would cost less.

SALT AND HEAT EXHAUSTION

Science Service

DILUTE sea water or salt water in any palatable form may be the basis of future soft drinks for hot weather

SCIENCE

VOL. LVIII NOVEMBER 16, 1923 No. 1507

CONTENTS

SCIENCE: A Weekly Journal devoted to the Advancement of Science, edited by J. McKeen Cattell and published every Friday by

THE SCIENCE PRESS

Lancaster, Pa. Garrison, N. Y.
New York City: Grand Central Terminal.

Annual Subscription, $6.00. Single Copies, 15 Cts.

SCIENCE is the official organ of the American Association for the Advancement of Science. Information regarding membership in the association may be secured from the office of the permanent secretary, in the Smithsonian Institution Building, Washington, D. C.

Entered as second-class matter July 18, 1923, at the Post Office at Lancaster, Pa., under the Act of March 3, 1879.

RECENT PROGRESS IN OUR KNOWLEDGE OF THE UNIVERSE[1]

IN his address at the dedication of the Yerkes Observatory in 1897, Simon Newcomb said, "If it be true that in nature nothing is great but man, in man nothing is great but mind, then may knowledge of the universe be regarded as the true measure of progress." Without discussing the validity of the premises which Newcomb himself casts in the conditional mood, let us boldly accept his conclusion and take time this evening to consider the progress we have made in the last thirty-five years by reviewing the increase of knowledge of the universe within that period. The time and the occasion are propitious for such an inquiry, for we are assembled to dedicate another great observatory; and this year, 1923, marks the 450th anniversary of the birth of Copernicus, whose book, "De Revolutionibus Orbium Coelestium," set the feet of men for the first time firmly on the road leading to knowledge of the universe and opened a new epoch in the development of the human mind.

The doctrine of Copernicus was more than epoch-making; it was revolutionary. The earth had been to men, in substance, the entire universe; the heavens a canopy drawn close about the earth; the sun, the moon, the planets and the stars merely greater or lesser lights set in that canopy for the comfort and delight of the dwellers upon the earth. Now they were asked to regard that earth as but a little planet, one of several revolving about a distant sun, and the stars, by implication, as vastly distant bodies that might rival with the sun in actual brilliance. No wonder that such heresy met with the most strenuous opposition; no wonder that only the boldest intellects became converts to it before Galileo, in 1609, turned the first small telescope upon the splendors of the sky and saw in the moons revolving about Jupiter a system, in miniature, resembling the one Copernicus had described.

I must resist the strong temptation to trace in detail the progress of astronomy through the centuries that followed. It is a brilliant story and one that has been told many times in prose and in verse. No one who has read it can have failed to note that advance in civilization closely paralleled the growth of man's knowledge of the universe, or to realize that this growing knowledge, by bringing man an ever-widening

[1] Address at the dedication of the Steward Observatory of the University of Arizona, April 16, 1923.

horizon, an ever greater freedom of thought, was a most potent factor in that advance.

Among the many conclusions that may be drawn from a thoughtful reading of this history, two are especially encouraging: First, that progress in astronomy has been continuous. From the days of Copernicus and Galileo the observations and generalizations made by any generation of astronomers have afforded the foundation upon which their successors could securely build. We have never had to go back and begin entirely anew, and even in our own times, observations of comets, of eclipses and of other objects and phenomena, made at dates preceding the invention of the telescope by many centuries, have been utilized to advance our knowledge. Secondly, that progress has been made at an ever accelerating velocity. At no period in history has the advance been so great as within the last few decades; and at no time has the promise for an increase of knowledge of the universe been as bright as it is to-day.

It was on June 1, 1888, almost precisely thirty-five years ago, that the newly completed Lick Observatory passed formally into the possession of the University of California and began its active work. Contrast the position of the astronomer at that date with his position to-day. The era of great telescopes was just opening; astronomical spectroscopy and photography were in their infancy; engineers were just beginning to develop practical methods of utilizing electricity as a motive power.

Since then four great observatories, besides the one at which we are gathered to-day, have been built on our own continent and several older ones have been rebuilt. If the advance in this respect has not been quite so great on other continents, still it has been remarkable everywhere and, in all, fully a score of powerful telescopes have been added to our equipment for exploring the universe. Particularly notable has been the development of the reflecting telescope since Keeler's work with the Crossley Reflector in 1898–1900 demonstrated the great efficiency of this type of instrument in many kinds of astronomical photography.

Coincident with the growth in the size and number of our telescopes has been the invention and improvement of auxiliary apparatus to utilize their great light-gathering powers in new ways and to increase the accuracy of our observations. The modern spectrograph, the spectro-heliograph, the precision photometers of various types, the bolometer, the pyrheliometer, the interferometer, the periodograph, have all come to use within the period I have named. Electric power and light are to-day as indispensable in our domes as in our most progressive industrial plants, and photographic observations have virtually displaced visual observations in all but a few lines of astronomical research.

Such greatly increased facilities, together with the remarkable progress in physics, in chemistry and in the methods of mathematical analysis, have put it within the power of astronomers to enter upon the study of a whole series of questions relating to the stars as organisms which earlier investigators had left practically untouched; not because they took no interest in them or failed to appreciate their importance, but simply because to them it seemed hopelessly beyond the power of the human mind to devise means of securing the data needed for their solution. It is in investigations along these lines that some of the most striking advances have recently been made, but the increase in our knowledge of stellar motions and of stellar distances is fully as great and as important.

The analysis of stellar radiations with the aid of our powerful spectrographs has enabled us not only to classify the stars according to the quality of their light but also to measure with high precision the velocities of the stars in the line of sight, and to discover, and even to compute the orbits of binary star systems that must forever remain invisible[2] to us, no matter how greatly our telescopes may be increased in size. We have made at least a beginning in the measurement of the temperatures, the masses, the densities, the angular and linear dimensions of the stars. We recognize "giant stars" and "dwarf stars"; stars intensely hot as compared with our sun and stars that are relatively cool; "young stars" just emerging, it may be, from an antecedent nebular stage, and "old stars," nearing the end of their history as luminous bodies. It would be easy to continue this catalogue until it filled many pages and to draw up one equally long of the achievements in researches relating to the structure of the stellar system. But it will be of greater interest, I think, to select one of them for more detailed presentation to illustrate modern methods and results.

Let us then consider a problem that has a history dating back to the days of Copernicus, the problem of determining the distances of the stars. The fact that the stars did not change their apparent position or direction from the earth in different seasons of the year, as they should do because of the earth's revolution about the sun, was regarded by the opponents of the Copernican doctrine as one of their strongest arguments against it and was the chief reason why so great an astronomer as Tycho Brahe rejected the doctrine. The proponents of the theory could only reply that the stars must be very far away, but all their efforts to find out how far did not yield a single stellar distance until nearly 300 years had elapsed. Their

[2] That is, no telescope can show both components of the closer spectroscopic binary stars, especially if they are unequal in their brightness. One component, or the unresolved image of the pair, must, of course, be visible.

work was by no means all in vain, for though it did not achieve the end for which it was undertaken it did lead to the discovery, by Bradley, of the phenomena of aberration and nutation and to the discovery, by Herschel, of the existence of the binary star systems. Moreover, it served to set a minimum limit to stellar distances, a limit that receded ever farther as instruments and observing methods improved. Even before the telescope was invented it was clear that the limit must be about 200 times the distance from the earth to the sun, for a lesser distance would cause displacements that could be detected by the unaided eye; by the middle of the 17th century it grew to 4000, early in the 18th century, to 20,000 or 30,000 times that distance. By the 19th century astronomers had become convinced that the nearest stars must be at least 200,000 times as far away as the sun, or, in technical terms, that the largest stellar parallax could not much exceed a second of arc. This term, parallax, is a convenient one and I shall use it in what follows. It signifies the angle at the star between lines drawn from the star to the sun and to the earth, respectively; the farther away the star, the smaller the angle. Having this angle, we readily determine the distance, for in the triangle, earth, sun, star, we know one side, namely, the distance from the earth to the sun, and all the angles.

Finally, in the years 1838–39, three astronomers, working in different places, with instruments of different types, announced almost simultaneously the parallaxes of three different stars; Bessel, the parallax of 61 *Cygni*, measured with the heliometer, Henderson, the parallax of Alpha *Centaur* determined from meridian circle observations, Struve, the parallax of Alpha *Lyrae*, from micrometer measures with his equatorial telescope. Success being thus achieved, after nearly three centuries of unavailing endeavor, it might have been anticipated that knowledge of stellar distances would grow rapidly, particularly in view of the constant improvement in instruments and the ever better understanding of the requirements of the problem. Actually, however, progress was slow. By 1880, it is fair to say, we had approximate values of the distance of but a score of stars; by 1900, of some three-score, only, and the prospects for rapid or great increase in number by visual observations were by no means encouraging.

But by this time methods of photographing the stars and of measuring their positions on the resulting plates had been developed to such a degree that it seemed feasible to attack the extremely difficult problem by the photographic method. Pritchard, at Oxford, indeed, had taken a large number of photographs for this purpose as early as the years 1887–1889, and these had led to the parallaxes of 28 stars. His work deserves high praise, even though it has since been found that his results are affected by systematic errors of considerable size. Early in the present century, however, when Kapteyn had definitely enunciated the "reasonable precautions" that must be taken by the observer, first at the telescope and then at the measuring microscope; when Turner and others had developed the exceedingly accurate modern methods of plate measurements; when Schlesinger had shown how to eliminate in large degree the very troublesome "guiding error"; then it became possible to enter hopefully upon a greatly extended program of parallax work.

In the meantime astronomers had been learning the lesson so thoroughly drilled into the heads of baseball and football men by their coaches—that good teamwork is fully as essential to the winning of games as brilliant individual play. Cooperation in astronomical research was by no means a novelty in the latter half of the 19th century, but in the 20th century it has become one of the distinctive features of our work. The photographic determination of parallaxes affords an excellent illustration. While each individual guards and preserves his right of initiative, astronomers at seven observatories, six in America and one in England, have formulated a cooperative program that ensures the elimination of useless duplication of labor and as great a degree of homogeneity in the results as differences in instrumental equipment and observing conditions will permit. Now they are engaged in that most generous form of rivalry in which each one gives all the others the benefit of any improvement in methods of manipulation or of computation he has devised, applauds every success the others achieve, and strives for even greater success himself. It is, therefore, not surprising, though extremely gratifying, that by 1915 we had the parallaxes of at least 200 stars and that now the number is well past the thousand mark and is growing at the rate of perhaps 150 to 200 a year.

At the same time we must face the fact that the number of stars whose parallax can be measured directly with the best of modern telescopes and with the most scrupulous attention to every detail of observation and measurement is strictly limited and pitiably small in comparison with the total number even of the brighter telescopic stars. In 1915, Sir Frank Dyson considered 0″.02 the smallest parallax that could be measured with any reasonable degree of accuracy. Translated into other terms, this means that if a star is more than ten million times as far away from us as the sun is, we can hardly hope to measure its distance. To-day, eight years later, this may perhaps be regarded as a rather conservative statement, but even to-day no responsible astronomer would care to set a limit very much greater. It is

true that by any terrestrial standard of distance 10 million times that to the sun is enormous, and that no human intelligence can comprehend it. Yet we have every reason to believe that the stars within a sphere of space of this radius do not number more than 20,000 to 25,000 (half of them probably too faint for photographic parallax measurements), whereas the number in our stellar universe is of the order of 1,000 million.

We now open a new chapter of our story. There is an obvious relation between the apparent brightness of a luminous object, its intrinsic or true brightness and its distance from the observer. Two lights may appear to be of equal brightness, because they really are equally bright and are at the same distance from us, or because the one of greater intrinsic brightness is farther away, the law of variation of brightness with changing distance being the well-known law of the inverse square; double the distance and the light is diminished to one fourth its former brightness; halve it and the light is increased fourfold.

Thanks to the efficiency of modern photometers and to the extensive and skillfully executed researches which have led to an accurate scale of visual and of photographic magnitudes, we can now determine with all desired accuracy the apparent brightness or magnitude of any star down to the faintest ones revealed by our telescopes. If then, by some means, we can also determine its *intrinsic* brightness or its "absolute magnitude" (the magnitude it would have at a definite distance from us) it is clear that its distance becomes known. But how is it possible to know anything about the actual luminosity of a star until we know how far away it is? As recently as the opening year of the present century the problem might well have been declared insoluble. Fifteen years later the answer was found in the correlation between the relative intensities of certain spectral lines and the intrinsic brightness of stars of the same spectral class.

This is not the place for a detailed explanation. It must suffice to say that we have ascertained from laboratory experiments and from solar observations that the character and intensity of certain spectral lines are strongly affected by changes in the physical conditions in the light source. Now, "if two stars which have closely the same type of spectrum differ greatly in luminosity it is probable that they also differ greatly in size, mass and in the depth of the atmospheres surrounding them. Accordingly, we might hope to find in these stars certain variations in the intensity and character of such spectrum lines as are peculiarly sensitive to the physical conditions of the gases in which they find their origin, in spite of the close correspondence of the two spectra in general." Adams, whom I have been quoting, was not the first to search for such lines, but it was he who first succeeded in using them to determine stellar parallax. His paper describing the method was published in 1916; five years later he and his collaborators were able to publish a list of the parallaxes of 1646 stars; and these values are of the same order of accuracy as the best photographic ones.

The method has not as yet been successfully applied to stars of all spectral classes, but we may look forward with confidence to its further extension. Thousands of stellar spectrograms, taken for other purposes, are also available at several of our great observatories, and it is certain that many of these will be utilized for parallax determinations by this new method. Great, therefore, as has been the recent advance in knowledge of the distances of individual stars, the prospects are bright for still more rapid progress in the coming years. For there is, practically, almost no limit to the number of the stars whose distances can be measured by the spectroscopic method. To determine uniquely the absolute magnitude of a star we need only spectrograms on a scale sufficiently large to record accurately the relative intensities of the spectrum lines, and as our instrumental equipment grows more powerful we may hope to get such spectrograms of ever fainter stars.

I have treated this problem of the determination of stellar distances at considerable length not only because of its intrinsic importance in our studies of the structure of the universe, but because it illustrates admirably many of the characteristics of modern astronomical research, and, in particular, the fact that advance in any one line is so closely correlated with and dependent upon advance in others which are seemingly entirely unrelated to it. Nothing, for example, could have been farther from the thoughts of those who were investigating the behavior of the spectra of gases under different physical conditions than that their results would be applied to the determination of the distances of the stars.

Let me now continue my story by reviewing more rapidly some of its other developments. The determination of the position of stars upon the surface of the celestial sphere is one of the oldest forms of astronomical observation, dating back to the days of Hipparchus. The first catalogue giving star places of sufficient accuracy for comparing with modern meridian observations is Bradley's, about the middle of the 18th century. Since then, by the patient, skilful labor of scores of able astronomers an enormous mass of data has been accumulated and made available for analysis by statistical methods. Comparison of the positions of stars observed at different dates shows that these are changing; slowly, indeed, but in many instances rapidly enough to make the change measurably great within a few years or decades or a century

or two. Herschel utilized the scanty knowledge of such motions—proper motions, we call them—available in his day to prove that they were due in part to the actual motion through space of the solar system itself; and with the insight, and, may I add, the good fortune of genius, he was able to estimate the direction of this motion with amazing accuracy.

It is obvious that the motion of the sun through space provides the astronomer with an ever-lengthening base line from the extremities of which he can observe the positions of the stars and hence their "parallactic" displacement. These observations do not lead to the distance of any particular star, because the star's own motion is a factor in its displacement; but, assuming as a first approximation that the stars are moving quite at random; that, in the average, in any given area of the sky as many stars are moving north as south, east as west, towards us as away from us, they do lead to a knowledge of the *average* parallactic displacement of the entire group and hence to the *average* distance of the stars in it. Within the past twenty-five years men like Kapteyn, Campbell, Boss, Dyson, Charlier, to name but five of an illustrious company, have been engaged in a series of brilliant researches on the motions of the stars. Campbell, it is true, has been concerned entirely with the motions of the stars in the line of sight, as determined with the spectrograph, but it will appear immediately that his measures have the greatest significance in the questions I am discussing. Remarkable, indeed, are some of the results obtained. Thus Boss demonstrated that a number of stars apparently unrelated and widely scattered in the region of the constellation *Taurus* are really moving together through space along practically parallel lines. The spectrograph supplied the radial velocities of a few of the brighter members of the group, and the combination of the data on simple geometrical principles led directly to an accurate knowledge of the distances of every star in the group. Several such "moving clusters" are now recognized and are the subjects of fruitful study.

Still more striking was the announcement by Kapteyn, in 1904, that the stars as a whole are divided into two great streams moving towards vertices at two diametrically opposite points in the plane of the Milky Way. The stars of the two streams are thoroughly intermingled and members of either stream are to be found in every part of the sky, being distinguishable only by their motions. This conclusion has been abundantly verified by later investigations and stands as one of the most important contributions yet made to our knowledge of the stellar system.

Again, Campbell and Boss, quite independently and almost simultaneously, announced that the stars of different spectral classes are moving through space with different velocities.[8] The stars of Class B, the blue white stars, at one end of the series of spectral classes, have the smallest average velocity; and the velocity increases, class by class, as we pass from the white stars through the yellow stars on to the red stars of Class M at the other end of the series. Each investigator gave values for the average velocity, and also for the average parallax of the stars in each group; Campbell from an analysis of the radial velocities of the stars after making correction for the sun's motion through space, the velocity of which his researches measured for the first time, Boss from a similar analysis of the proper motions; and the two sets of figures were in excellent accord.

Carrying his work still farther, Kapteyn was able to calculate the approximate *average parallax* or distance of stars of every order of magnitude and of every spectral class. Thus, these diverse researches on the distances of individual stars, on star positions and proper motions, on radial velocities, and on the quality of lines in stellar spectra are all made to focus upon the great fundamental problem of the form and structure of the stellar universe.

I have by no means enumerated all the investigations which bear upon this great problem. I have said nothing, for example, of the binary stars. I might show how they lead us to a knowledge of stellar masses and densities; and, conversely, since we find the range in mass to be relatively small, how we can compute the "hypothetical parallaxes" of the visual binaries (as Jackson and Furner have recently done for more than 550 pairs) by assuming an average value for the mass. Or I might ask you to consider the variable stars, and especially the Cepheid variables, and show how Miss Leavitt's discovery that in the Cepheids in the Smaller Magellanic Cloud a definite numerical relation exists between the magnitude of the star and its period, that is, the length of one complete cycle of light variation, enabled Hertzsprung to estimate the distance of the Cloud itself and put into the hands of Shapley a new gigantic "yard-stick" with which he has measured the distances of the globular star clusters and the dimensions of the stellar system.

The precise length of this yard-stick depends upon the absolute magnitude of the nearer Cepheid variables, and it may well be that further observations will modify to some degree the value adopted by Shapley; the *validity of its use* rests upon the assumption that the relation between magnitude and

[8] Kapteyn's independent investigations led him almost simultaneously to the same general conclusions. More recent investigations indicate that this apparent correlation between velocity and spectral class may prove to be, physically, a correlation between velocity and mass, the less massive stars having the greater space velocity.

period which holds for the Cepheids in the Magellanic Cloud is independent of the star's environment and characterizes these variables wherever they appear, whether in space comparatively near us or in the most distant star cluster. The assumption has been challenged and it is not impossible that it may prove to be invalid; but it is supported by so much corroborative evidence that it commands ever more respect and credence.

A similar remark applies to many other generalizations as to the structure and dimensions of the universe. *Quantitatively*, they are admittedly approximations which are to be corrected and improved as additional data of observation are accumulated. They also involve *assumptions*, some of which can not be submitted to direct tests, but which are adjudged valid because they seem to be in harmony with accepted physical laws and give results which agree with observation. Some of them, no doubt, will have to be modified; some may have to be abandoned entirely. But it is certainly an inspiring fact that, imperfect and limited as our knowledge is, it is yet sufficient to have enabled Kapteyn, in the last paper published before his death last year, to formulate—with hesitation and some misgivings, it is true, but yet with confidence in the principles involved—"a tentative theory of the dynamical organization of the stellar universe."

The researches which I have been reviewing relate chiefly to one of the two fundamental problems of astronomy; the other is that of stellar evolution. This is distinctly a problem of our own times, one that could not be attacked until spectroscopy and photography had been successfully applied in stellar observations, until modern methods of solar research had been developed, and physicists and chemists had given us a better insight into the properties of matter and especially of matter in the gaseous state.

Observationally, stellar spectra provide the first and by far the most important data for the study of stellar evolution, and for the vast accumulation of such data now available astronomers gratefully acknowledge that they are indebted most of all to the late Professor Pickering and his colleagues at the Harvard College Observatory. The monumental "Henry Draper Catalogue of Stellar Spectra," of which seven volumes have already been distributed, contains the classified spectra of more than 200,000 stars. The first remarkable fact to be noticed is that fully 99 per cent. of all the stars whose spectra have been examined fall into one or the other of only six great groups, designated by the arbitrary letters B, A, F, G, K and M. The next is that these groups grade into each other in such a way as to form a continuous linear series, the color deepening from white through yellow and orange to red as we pass from B to M. The classification is on an empirical basis depending simply upon the characteristics of the spectral lines; but the continuity and particularly the linearity of the series is strong evidence, in Russell's words, "that the principal differences in stellar spectra, however they may originate, arise in the main from the variations in a single physical condition in the stellar atmosphere." All astronomers now agree that this dominant physical condition is temperature, a conclusion that has been abundantly confirmed. We have even been able to measure stellar temperatures directly by the use of extremely sensitive thermocouples in conjunction with some of our great reflecting telescopes, and thus have definite knowledge that the intensely white Class B stars are the hottest, the red Class M stars the coolest in our series. These facts point to a genetic or evolutionary relationship between the stars of successive spectral classes; the question is as to the direction in which the evolution proceeds.

Within the past decade data for the discussion of this question and the related question of the status of matter antecedent to the stellar stage have been offered in such abundance, in such variety and in such rapid succession as fairly to bewilder the conservative mind. The astronomer has been applying his telescope to the measurement of the radial velocities of the nebulae and has found not only that the planetary nebulae are moving at speeds greater than those of the most rapidly moving stars (on the average), but that the velocities of the spirals are so much greater still as to be of an entirely different order. He has found that the planetaries, with but few apparent exceptions, are rotating on their axes; he is adducing ever stronger evidence that the matter in the arms of spiral nebulae is moving outward along the curves of the arms. He has shown that the great diffuse gaseous nebulae have such low velocities as to be practically at rest with respect to the stellar system; and, further, that diffuse nebulous matter capable of obstructing rather than of radiating light is extraordinarily abundant. He has studied the distribution in the sky and especially with reference to the galactic plane, of stars of different spectral characteristics, of binary stars, of variable stars, of nebulae of the different types, and has found, for example, that the red stars of Class M, whether bright or faint, are distributed over the sky almost at random and that they exhibit no relationship of position to the diffuse nebulae, whereas the stars of Class B, among others, are strongly concentrated towards the plane of the Milky Way and show a marked apparent affinity for the diffuse nebulae.

While observatories and astronomers in all parts of the world have been making effective and valuable contributions in such researches, it is a matter of legitimate pride that the astronomers in our own coun-

try, using our great modern telescopes, and particularly those in our Pacific area, have been among the leaders in nearly all of them.

All this material and far more, including the ever-growing volume of data on the visual and spectroscopic binary stars, on variable stars and on solar phenomena, the astronomer is placing at the disposal of the student of stellar evolution; and it is only fair to say that the latter is availing himself of it all and of all the progress made by physicists and chemists in their researches on the properties of matter, eagerly and effectively. It would be interesting, did time permit, to follow in detail the development of evolutionary theory during the past thirty-five years, but, passing scores of valuable contributions by Schwarzschild, Eddington, Jeans and many others without a reference, I can only take time to present most summarily and imperfectly the theory which now, in its general features, commends itself strongly to the majority of astronomers. It was first proposed by Lockyer, so far as its fundamental principle goes, but it has been so expanded and enriched and in many features so radically modified by Russell and so brilliantly presented and defended by him that we commonly refer to it as Russell's theory.

Briefly, the theory assumes that in the beginning of their stellar stage all stars are of Class M. They are then bodies of gas of extraordinarily low density and of low temperature and surface brightness. As they contract they grow ever hotter and pass through the successive spectral classes towards B, but only the more massive stars can generate heat enough to reach the white-hot state required to produce spectra of Class B; the others reach their critical density at spectral Class A, F, G or even K. After this critical point in their contraction is reached the stars begin to fall off in temperature and in luminosity and gradually pass through the spectral classes in the reverse order until they again become red stars of Class M before they finally sink to invisibility. The stars on the ascending branch are, in the terminology introduced by Hertzsprung, chiefly "giants," those on the descending branch chiefly "dwarfs," the terms "giant" and "dwarf" referring to luminosity rather than to mass.

On this theory the very bright red stars of Class M must be giants of enormous volume to compensate for their low surface brightness. On the basis of observational and theoretical data Russell and Eddington, independently, calculated the "hypothetical" diameters of some of these stars, and it is one of the most cogent arguments in favor of the theory that the recent interferometer measures of Betelgeuse and of Antares at the Mount Wilson Observatory, which constitute one of the most brilliant achievements of modern observational astronomy, are in excellent agreement with these predicted values.

Innumerable difficulties remain to be overcome, innumerable questions to be answered; but in the investigation of stellar evolution as in the investigation of the form and dimensions of the stellar universe, we may at least feel that our feet are set firmly on the road to fuller knowledge.

What of the future? Prediction would be worse than vain. Who, thirty-five years ago, could foresee the discovery of star-streaming, of the correlation of stellar velocity with spectral class, of the applicability of stellar spectra to the measurement of stellar distances? One thing, and only one is certain. Never have the opportunity and the need for good work, well-planned, skilfully executed work, in observational astronomy been as great as they are to-day. In his able address to the American Astronomical Society, Schlesinger recently presented the urgent need of extensive observations of star positions to provide further data on proper motions. It would not be at all difficult to show at least equal need for measures of the radial velocities of stars and nebulae; for measures of stellar distances; for photographic investigations of nebulae and of star-clusters; for qualitative studies of stellar and nebular spectra; in brief, for extensive additions to every form of observational data on the motions and radiations of the nebulae and of the stars.

To secure these additions to our knowledge we must have observatories equipped with powerful modern telescopes and their accessory instruments, and we must have more trained observers. For material equipment and support we must look to a generous public and we shall not look in vain if we, who are learning a little about this great universe of ours, tell what we learn and make it part of the common knowledge of our time. For trained observers we must turn, first of all, to the students of our universities. I count it, therefore, a matter for special congratulation that this new observatory, the gift of a private citizen, a public spirited woman, equipped with the first powerful telescope whose *optical* as well as mechanical parts were all made in our own country, located in a most favorable climate, and directed by an able astronomer of wide experience, is so closely associated with a vigorous and rapidly developing university. It will be its high privilege not only to make significant contributions to our knowledge of the universe—knowledge that promotes the progress of which it is itself the true measure—but to inspire eager youth who, when we of the older generation one by one lay down the torch, will

> Take . . . the splendor, carry it out of sight
> Into the great new age (we) must not know
> Into the great new realm (we) must not tread.

Robert G. Aitken

Lick Observatory

CHARLES PROTEUS STEINMETZ[1]

THE whole world, through its orators and writers, has expressed so beautifully and so well its appreciation of Charles Proteus Steinmetz that if I attempted to express what is in my heart, it would be but to repeat what has already been said much better by others. However, as his devoted friend and intimate associate for one third of a century, as one who recognized his great talents when he was unknown, and surrounded him with a favorable environment for the development of his genius, I regard it as a privilege to publicly endorse all that has been said of his usefulness, his commanding genius, his inspiring personality. This cheerful, patient, kindly spirit, this zealous student of nature and lover of humanity was your friend and my friend.

I have been asked to speak of his scientific attainments and their meaning to the world. To do this properly would be to cover much of the history of the electrical industry during the past 30 years. I must confine myself to sketching such features as seem of most importanec and possibly of greatest interest.

Thirty years ago I first met Steinmetz. The occasion was as follows: The General Electric Company had been recently formed by the union of the Edison Company and the Thomson-Houston Company, which brought into one enterprise the results of the work of Edison, Elihu Thomson and many other early pioneers in the fields of arc and incandescent lighting, electric traction and industrial motor application.

Rudolph Eichmeyer, of Yonkers, had developed some interesting designs for electric traction purposes, and certain novel and economical forms of windings for armatures of electrical machines. I was then in charge of the manufacturing and engineering of our company and my views were sought as to the desirability of acquiring Eichmeyer's work. I remember giving hearty approval, with the understanding that we should thereby secure the services for our company of a young engineer named Steinmetz. I had read articles by him which impressed me with his originality and intellectual power, and believed that he would prove a valuable addition to our engineering force.

I shall never forget our first meeting at Eichmeyer's workshop in Yonkers. I was startled, and somewhat disappointed by the strange sight of a small, frail body surmounted by a large head, with long hair hanging to the shoulders, clothed in an old cardigan jacket, cigar in mouth, sitting crosslegged on a laboratory work table. My disappointment was but momentary and completely disappeared the moment he began to talk. I instantly felt the strange power of his piercing but kindly eyes, and as he continued, his enthusiasm, his earnestness, his clear conceptions and marvelous grasp of engineering problems convinced me that we had made a great find. It needed no prophetic insight to realize that here was a great man, one who spoke with the authority of accurate and profound knowledge and one who, if given the opportunity, was destined to render great service to our industry.

I was delighted when, without a moment's hesitation, he accepted my suggestion that he come with us.

Steinmetz had already made his first important contribution to electrical science in investigations of magnetism, and especially in formulating and determining the laws governing the losses in iron subjected to varying magnetic induction. He showed that the hysteresis varied as the 1.6 power of the density of magnetic flux. This made possible for the first time the exact predetermination of the so-called iron losses in the armatures of electric motors and generators and in the transformers and other electrical apparatus employing iron. As a result, the quality of our electrical machinery was improved, and the weight and costs reduced. It is difficult at this date to realize the fundamental importance of this one contribution to the orderly and definite progress of the electrical industry.

During the first decade of the commercial application of electricity to light and power which may be said to cover the period between 1880 and 1890, direct current only was used. This was the basis of the Edison system, the Thomson-Houston arc system, the Vanderpool and Sprague railway motor systems. The laws governing the flow of direct current were simple and easily understood, and could be treated by mathematics of the most elementary character.

About the time Steinmetz came with the General Electric Company in 1893, the use of alternating current for lighting, power and other purposes was just beginning to be of demonstrated commercial value. Advance in the commercial use of alternating current was hindered by the extreme difficulty of understanding the technical nature of its action and of the various phenomena connected therewith. The engineer who had been working with direct current found it difficult to understand and therefore to correctly design alternating current apparatus. While the problems of the direct current apparatus and electric circuits could be treated by the simplest mathematics such as ordinary arithmetic, the alternating current, involving such phenomena as reactance, capacity, leading and lagging currents, phase displacements, etc., could apparently only be solved by higher mathematics involving the use of calculus methods which were not generally familiar to the engineers of those days. Even skilled mathematicians familiar with such

[1] Address delivered at the Memorial Meeting in Schenectady, October 31, 1923.

methods made slow and difficult progress in the solution of the problems which arose daily.

Steinmetz took hold of this situation with characteristic energy, and soon brought order out of chaos. He abolished the mystery and obscurity surrounding A. C. apparatus and soon taught our engineers how to design such machines with as much ease and certainty as those employing the old familiar direct current.

He had already made the discovery that alternating current problems could be attacked and solved with success by the use of what was known as complex quantities. By the use of this system he not only was able to solve these problems himself, but to teach our engineers to do the same work by methods almost as simple as ordinary arithmetic and algebra. Steinmetz himself regarded this as one of his greatest contributions and called it the development of the "symbolic method of alternating current calculations." This method was found to be so powerful, accurate and rapid that its use was not confined to the engineers of our company, but rapidly spread throughout the world. He preferred to use this mathematical method in the treatment of all problems of alternating current engineering which arose and advocated its use before the American Society of Electrical Engineers in numerous papers, and embodied it in the text-books of which he was author.

Not only did the adoption of these mathematical methods open the door to many to do useful design work who otherwise could not have done so, but it enormously increased the speed with which definite and accurate calculations and designs could be made. It furnished the engineer with a powerful tool which multiplied his power with just as much certainty as the machine tool improves and multiplies the usefulness of the ordinary workman.

It was fortunate indeed for our company and for the electrical industry that Steinmetz became associated with us at the critical time when the alternating current development had just started. It is not too much to say that his genius and creative ability, not only in his own personal work, but in advocating and obtaining the general use of a simple mathematical system for treatment of A. C. problems, were largely responsible for the rapid progress made in the commercial introduction of alternating current apparatus.

Steinmetz's practical inventions literally cover the entire field of electrical applications: Generators, motors, transformers, lightning arresters, lighting, heating and electrochemical operations. Of these many inventions, which were set forth in some 200 patents, perhaps the most important are the induction regulator, the method of place traisformation, as from two phase to three phase, and the metallic electrode arc lamp.

His experimental work in arc lighting led to the production of the magnetite arc. The practical advantage of this type of lamp is found in the extreme length of time which the metallic electrode will burn without recharging—these electrodes burning 200 hours contrasted with a life of 70 hours in the carbon arc used before his time. The efficiency also of this type of lamp, especially in small units of illumination, was of great commercial value.

He devoted much time to the development of the mercury arc and by his masterly methods did much to improve this interesting and important type of illumination. These and many other of his inventions have found permanent and extensive use in the industry.

During the last ten years, when alternating current power transmission lines of great length, carrying large amounts of energy, have spread all over the country, to use his own words, "an old enemy became more and more formidable—lightning," and for many years the great problem which pertained to the successful development of electrical engineering was that of protection from lightning. Before this could be undertaken with reasonable hope of success we must know a great deal more about lightning and centered phenomena. This led to the investigation of transient phenomena. It was soon found that while lightning might have been the criminal which started the trouble in the electrical system, the damage and destruction was not done by lightning, but by the electric machine power back of the circuit which was let loose and got out of control by the disturbance initiated by lightning. He goes on to say that the study of the phenomena produced by lightning effects could in general be grouped under the name of "transients" because, unlike the direct and alternating currents which flow continuously, these disturbances last a limited time only. The study of this problem led him to produce his famous "lightning" generator of which so much has been told in the public press. In the hands of Steinmetz and his assistants such progress has been made that the nature of the phenomenon has been so elucidated that as a result it is possible to proceed with confidence in the further development of the large high-powered transmission systems, making possible Steinmetz's vision that the day was rapidly approaching when the electrical engineer would supply the world's requirements of energy over transmission lines which would cover the country with a network similar to that of the railways, the one taking care of the distribution and supply of energy, and the other carrying the materials.

Steinmetz was an ardent believer in the value of education. He not only found time to aid the educational work of Schenectady, but became president of the national association of corporation schools and

lecturer at Union College. In a masterly address, upon retiring as President of the American Institute of Electrical Engineers in 1902, he stated that all future progress in science and engineering depends upon the young generation, and to insure unbroken advance it is of preeminent importance that the coming generation enters the field properly fitted for the work.

His personal example, his spoken words and his writings have had a powerful and beneficial influence upon the development of education, especially technical education in this country.

That I have not overstated the value of Steinmetz's work in this early period is indicated by the message of an eminent electrical engineer, Professor Harris J. Ryan, president of the American Institute of Electrical Engineers, who says: "Through a period of years Dr. Steinmetz stood almost alone as the one electrical engineer in the world capable of defining and solving the many perplexing problems encountered for the understanding and improvement of the transformer, induction motor, alternator and polyphase high voltage system, the modern fundamental implements of the electrical engineer."

That the value of Steinmetz's services were not limited to the General Electric organization is well known, but it is satisfactory to have the testimony to that effect by the president of a great electrical manufacturing company who states: "He has been such an outstanding figure in engineering work for so many years and is so well known to the public that his death will be a great loss not only to the profession but to people generally."

One of our largest customers offers the following tribute: "He was untiring in his devotion to the development of the electrical industry and in his passing the industry has suffered an irreparable loss."

From far Japan comes the following comprehensive and beautiful encomium: "He spent his life serving humanity."

A representative of the greatest electrical manufacturing company in Germany offers the following tribute: "It will always remain one of the highest merits of your company that he found here the congenial environment and support necessary for a genius like his to develop to the fullest benefit of mankind."

Professor Elihu Thomson, one of our country's greatest scientists and electrical engineers, a man whom all the world delights to honor, sends this tribute: "In the death of Dr. Steinmetz the science of electrical engineering has lost a great leader, whose talents were most exceptional. Nearly a third of a century has passed since he displayed a faculty amounting to genius in the application of mathematical methods to the solution of difficult problems in electrical work, and throughout the subsequent period this special work of his has been followed up unremittingly. His numerous books and papers, his lectures and discussions will in themselves constitute an imperishable monument for all time. His long connection with the General Electric Company gave him the needed opportunity to put into extensive practice his ideas, and the resulting value to the industry itself can not be measured or estimated. The whole science of transient phenomena in electric circuits is virtually his, and he had the qualities of the patient teacher and expositor to those seeking information as students or listeners to his discourses. Only those who have followed his career, so full and so fruitful, can know the vacancy created by his absence from among us."

I must now bring to a close this inadequate sketch of the contributions of this remarkable man to the development of the electrical science and industry. During his short life he rendered services of the most conspicuous character and inestimable value.

He was the author of many original scientific papers and of a large number of electrical books which have been the accepted standards in colleges, laboratories and workshops everywhere.

He was a prolific inventor, a skilled mathematician, a trained engineer and an inspiring teacher. Our generation has produced men who have equalled or excelled him in some one of these fields, but no one has arisen who, to such a superlative degree, combined the qualities of inventor, mathematician, engineer and teacher.

He possessed a marvelous insight into scientific phenomena and unequalled ability to explain in simple language the most difficult and abstruse problems.

Countless electrical engineers now occupying positions of great importance in our company and elsewhere in the world gladly give testimony of their debt to him.

He was patient, sympathetic, cheerful and ever willing to share his great gifts with all those who sought his counsel.

He loved children and they loved him. A neighbor and his wife were mourning his loss in the presence of their children, when the father exclaimed with deep emotion, "and he was my friend." His little son of seven years looked up from his play and said: "He was my friend, too, daddy."

We, his fellow citizens, friends and associates, join the great world in mourning his loss, but may our grief be tempered by the memory of his great achievements which make his name the synonym of high service to humanity.

E. W. Rice, Jr.

Honorary Chairman of the Board,
General Electric Company

SCIENTIFIC EVENTS

THE NORTHWEST SCIENTIFIC ASSOCIATION

THE Northwest Scientific Association was organized at a meeting held at 4:00 P. M., April 6, 1923, in the Lewis and Clark High School, Spokane, immediately following the regular sessions of the Inland Empire Teachers Association. According to the newly adopted constitution, the object of the association "shall be the promotion of scientific research and the diffusion of scientific knowledge."

This new association opens its doors to any one interested in the various lines of scientific endeavor in botany, bacteriology, zoology, agriculture, mathematics, astronomy, physics, chemistry, geology and geography, anthropology, ethnology, psychology, education, social and economic sciences, historical and philological science, engineering, medical science and manufactures and commerce. It is the expectation that the membership will be drawn very largely from the Pacific Northwest, including the states of Oregon, Idaho, Montana and Washington and the Canadian provinces of British Columbia, Alberta and Saskatchewan.

Forty-five charter members were enrolled at the organization meeting, which was brought about very largely through the efforts of Professor Thomas Large, of the Lewis and Clark High School, Spokane. Opportunity has been offered for any others interested in science to become charter members and as a result the original group has been increased to 134 on June 30, when the list of charter members was closed. It is confidently expected that the new organization will become a real dynamic force in the northwest.

One or more regular meetings will be held each year for the presentation and discussion of papers. As the membership grows, it is expected that special divisions or sections will be organized, but this will depend entirely upon the membership and the interest manifested. This association is being welcomed by scientific workers of the Pacific northwest, as it will bring together groups that have been unable to attend the scientific meetings east of the Rockies or the distant Pacific Coast meetings.

It is not the idea of the association to interfere with any existing scientific societies, clubs or organizations, but it is the hope that the association may bring about an affiliation of the various local organizations. It is hoped that local groups or clubs will be organized in the various universities, colleges, normal schools, high schools or communities which will promote acquaintance and friendship among scientific workers and stimulate a more active interest in science and scientific research.

The officers of the association are as follows:

President, Dean M. F. Angell, University of Idaho, Moscow, Idaho.

Vice-president, Dr. Curtis Merriman, Cheney Normal School, Cheney, Washington.

Secretary, Dr. F. D. Heald, State College of Washington, Pullman, Washington.

Treasurer, Professor E. B. Harris, Spokane University, Spokane, Washington.

Councilors, Dr. Morton T. Elrod, University of Montana, Missoula, Montana; Dr. A. L. Melander, State College of Washington, Pullman, Washington; Dr. H. S. Brode, Whitman College, Walla Walla, Washington.

F. D. HEALD,
Secretary

THE PENNSYLVANIA STATE COLLEGE BRANCH

THE local branch of the American Association for the Advancement of Science at The Pennsylvania State College held a symposium on "Fuel utilization" on Monday, October 29. The meeting was held in two sections, one from 4: 30 P. M. to 6: 00 P. M. and from 7: 30 P. M. to 10: 00 P. M. with intermission with dinner for the members and guests at six o'clock. The program was as follows:

4:30 P. M.

Introduction and discussion of combustion principles: DEAN E. A. HOLBROOK, of the School of Mines.

Sources and types of natural fuels: PROFESSOR C. A. BONINE, of the Department of Geology.

Analysis of the cost of a ton of coal: PROFESSOR W. R. CHEDSEY, of the Department of Mining.

Modified and substitute fuels: DR. D. F. MCFARLAND, of the Department of Metallurgy.

6:00 P. M.

Intermission and dinner at the University Club.

7:30 P. M. (immediately following dinner).

Heating the small house: PROFESSOR F. G. HECHLER, of the Department of Mechanical Engineering.

The comfort zone in house heating: PROFESSOR A. J. WOOD, of the Department of Mechanical Engineering.

The meeting was open to members and their wives and to members of the teaching and experimental staffs of the School of Engineering and the School of Mines. There was a good attendance, since the application of the principles of Fuel Utilization to house heating is a timely topic and one of considerable interest to householders.

THE AMERICAN SOCIETY OF NATURALISTS

THE forty-first annual meeting of the American Society of Naturalists will be held in Cincinnati, Ohio, on Saturday, December 29, 1923, in affiliation with the American Association for the Advancement of

Science, and in cooperation with the principal other biological societies. The meeting is under the auspices of the University of Cincinnati in whose building the sessions will be held.

Several papers on important biological subjects may be added to the morning program that is being arranged. Papers are not limited to any specific phase of the biological sciences, but should be of as general interest as may be. They should also be short. Members desiring to present papers should submit titles to the secretary before November 15, and should state the probable time required, and whether blackboard, chart space, lantern, etc., are needed.

A symposium on the general subject of "Morphogenesis" is being arranged for the afternoon, in cooperation with the Botanical Society of America and the American Society of Zoologists. Participation in the symposiums by Professors Harrison, Buller, Harper and others is assured.

The annual dinner, with the address of the president, Professor R. A. Emerson, will be given on Saturday evening.

Headquarters of the society will be at the Hotel Gibson.

Blank forms for the nomination of candidates for membership in the society may be obtained from the secretary. Attention is called to the rule that nominations must be in the hands of the executive committee at least a year before being acted upon. Accordingly, nominations to be voted upon in 1924 must reach the secretary before the close of the meeting of 1923.

A. FRANKLIN SHULL,
Secretary

UNIVERSITY OF MICHIGAN,
ANN ARBOR, MICHIGAN

THE MATHEMATICAL ASSOCIATION OF AMERICA

THE eighth annual meeting of the Mathematical Association of America will be held at the University of Cincinnati on Thursday and Friday, December 27–28, in affiliation with the American Association for the Advancement of Science, and the Chicago Section of the American Mathematical Society. On Friday afternoon there will be a joint session of the organizations, and on Friday evening there will be the usual joint dinner. At the first session of the association on Thursday afternoon, President Carmichael will deliver his presidential retiring address on the "Present state of the difference calculus and its prospect for the future." Other papers for this session and for the session on Friday morning will be announced in the full program which will be sent to members as usual early in December. At the joint session on Friday afternoon there will be addresses by Professor G. A. Miller as retiring chairman of Section A of the American Association for the Advancement of Science on "American mathematics during three quarters of a century," by Professor A. B. Coble as retiring chairman of the Chicago Section "On the equation of the eighth degree," and by Professor L. E. Dickson on "Algebras and their arithmetics," by invitation of the Mathematical Association and of the Chicago Section.

Because of the Cincinnati meeting of the American Association for the Advancement of Science, our members will enjoy a reduced rate for these meetings, amounting to a fare and a half. This will thus afford an unusual opportunity for our members throughout the Middle West, as well as from points farther west and east.

The Hotel Sinton will be the headquarters for the members of the Mathematical Association.

W. D. CAIRNS,
Secretary

THE THORNDIKE MEMORIAL LABORATORY OF THE BOSTON CITY HOSPITAL

THE Thorndike Memorial Laboratory of the Boston City Hospital was formally opened on November 15. The dedication exercises were presided over by Dr. Henry S. Rowen, representing the board of trustees, and addresses were made by His Honor, James M. Curley, Mayor of Boston; Dr. William J. Mayo, of Rochester, Minnesota, and Dr. Townsend W. Thorndike, of Boston.

The new building was made possible by the bequest of the late Mr. George L. Thorndike, a merchant of Boston, who left his residuary estate to the trustees of the Boston City Hospital for the erection of a building which was to be equipped and supported by the city. The basement and ground floor are devoted to the X-ray department and the three upper floors form a division for clinical research. The second floor is a ward for nineteen beds, the majority being in single or double rooms, while the third and fourth floors contain laboratories for research in chemistry, physiology and biology.

The Boston City Hospital has at present about 1,200 beds and from this large number of patients selected groups will be taken to the Thorndike Memorial Laboratory for special investigation. The members of the laboratory staff will be in part men who are on salary and are devoting themselves largely or entirely to research work, and in part volunteer assistants who give approximately half time to research. The members of the staff at present are: Francis W. Peabody, director; Joseph T. Wearn, Thomas R. Buckman, Robert N, Nye, Henry Jackson, Jr., G. O. Broun, Percy B. Davidson, Elmer H. Heath, Donald S. King, Gulli Lindh Muller.

The budget of the laboratory, both salaries and running expenses, is borne by the City of Boston. Its establishment thus constitutes a striking instance of the recognition of the value of research to a general hosiptal by the trustees of a municipal institution.

SCIENTIFIC NOTES AND NEWS

THE Nobel prize for medicine for 1922 has been divided between Professor Archibald V. Hill, professor of physiology in University College, London, and Professor Otto Meyerhof, professor of physiology in the University at Kiel, for work on muscular contraction.

DR. J. J. R. MCLEOD and Dr. F. G. Banting, between whom the Nobel prize for medicine for 1923 was divided, have each again divided the prize, so that Dr. J. B. Collip, professor in the University of Alberta, and Dr. Best, collaborators in the work, will each receive $10,000.

DR. WILLIAM W. KEEN will receive an honorary doctor's degree from the University of Paris on November 24, at the opening exercises at the Sorbonne amphitheater.

A SPECIAL congregation of the University of Manchester was held on November 10, when the Earl of Crawford, K.T., was installed as chancellor and honorary degrees were conferred on a number of distinguished persons, including Dr. J. G. Adami, F.R.S., vice-chancellor of the University of Liverpool; Sir Arthur Keith, F.R.S., conservator of the museum of the Royal College of Surgeons of England, and Sir J. G. Frazer, F.R.S., author of *The Golden Bough*.

THE gold medal of the Royal Society of Medicine was presented to Dr. F. Gowland Hopkins, F.R.S., Sir William Dunn professor of biochemistry in the University of Cambridge, when on October 30 Professor Hopkins delivered an address on "Stimulants of growth."

MR. ROSITA FORBES, the English explorer, was presented with the gold medal of the French Geographical Society on November 7 after she had delivered a lecture on her experiences. Mrs. Forbes recently returned from a trip to Morocco.

DR. CHARLES H. MAYO, Rochester, Minn., was elected president of the American College of Surgeons at the annual meeting held in Chicago on October 25.

SIR ARTHUR CHANCE was elected president of the Royal Academy of Medicine of Ireland on October 12.

BOHUSLAV BRAUNER, professor of chemistry in the Bohemian University, Prague, has been elected an honorary foreign member of the French Chemical Society.

THE *Journal* of the American Medical Association writes: "The tribute to Professor C. Eijkman on the twenty-fifth anniversary of his professorship at Utrecht was an imposing ceremony. An album was presented with signatures of the Netherlands friends and another is on the way from the Dutch East Indies, and thirteen brief addresses were made by representatives of the government and scientific societies, including the Society of American Bacteriologists. The microbiologists cited a long list of Eijkman's innovations, such as his test for fermentation and his study of thermolabile substances which check bacterial growth. A fund was endowed in his name to provide a medal for achievement in tropical medicine."

AT the annual meeting of the Royal Society of Edinburgh, on October 22, the following council and office bearers were elected: *President*, Professor Frederick O. Bower. *Vice-presidents*, Major-General W. B. Bannerman, Dr. W. A. Tait, Principal J. C. Irvine, Lord Salvesen, Professor J. H. Ashworth and Professor T. H. Beare. *General Secretary*, Professor R. A. Sampson. *Secretaries to Ordinary Meetings*, Dr. A. Lauder and Professor W. Wright Smith. *Treasurer*, Dr. J. Currie. *Curator of Library Museum*, Dr. A. Crichton Mitchell. *Councillors*, Professor H. S. Allen, Sir Robert Greig, Dr. J. Ritchie, Professors E. M. Wedderburn, T. H. Bryce, J. Y. Simpson, D'Arcy Thomson, Sir James Walker, E. T. Whittaker and H. Briggs, W. L. Calderwood and Professor T. J. Jehu.

THE College of Physicians of Philadelphia has awarded the Alvarenga prize of $300 to Dr. Edward P. Heller, Kansas City, Mo., for his essay entitled: "Treatise on Echinococcus Disease." The next award of the prize will be made on July 14, 1924, provided an essay deemed by the committee of award worthy of the prize shall have been offered.

AUGUST MERZ, of Heller and Merz, has been elected chairman of the dyestuffs section of the Synthetic Organic Chemical Manufacturers Association, New York City, to fill the vacancy caused by the death of Fred E. Singer.

DR. W. LEE LEWIS, head of the department of chemistry of Northwestern University, has been appointed director of scientific research for the Institute of American Meat Packers with headquarters in Chicago. The purpose of this division of the Institute's activities is to make a study of the research problems presented by the packing industry. The trustees of Northwestern University have granted Dr. Lewis a leave of absence from February 1, 1924, for a period of one year in order to allow him to devote his time to the organization of this work. This arrangement includes the continuation of the direction of research work under Dr. Lewis on carbohydrates

and organic arsenic compounds now being carried on at the university. During Dr. Lewis's absence Professor Frank C. Whitmore will serve as acting chairman of the department.

OTTO M. RAU, power specialist of Philadelphia, has been appointed in a consulting capacity to the staff of the Giant Power Survey for Pennsylvania.

AT the inauguration of Dr. Herbert Spencer Hadley as chancellor of Washington University, which occurred on November 10, the American Association for the Advancement of Science was officially represented by Dr. George T. Moore, director of the Missouri Botanical Garden.

DR. J. WALTER FEWKES, chief of the bureau of American ethnology of the Smithsonian Institution, left on November 5 for Florida, where for several months he will investigate Indian mounds and other relics of the pre-Columbian Indians.

DR. FREDERICK L. HOFFMAN, of Wellesley Hills, consulting statistician of the Prudential Insurance Company of America, sailed on November 10 to attend the Belgian cancer congress which will be held in Brussels from November 18 to 20. Dr. Hoffman will make an address on "Cancer and civilization." He expects to return to the United States early in December.

PAUL F. CLARK, professor of medical bacteriology in the University of Wisconsin, has recently returned from a semester's leave of absence spent in travel and study in Europe. After serving as a delegate at the Pasteur Centenary in Paris, Professor Clark worked in the laboratory of the Pasteur Institute in Brussels, under Professor Jules Bordet, and in the Molteno Institute of Parasitology in Cambridge, under Professor George H. F. Nuttall. Later in the summer he visited the laboratories of the more important London hospitals and of the University of Oxford.

J. R. LOVEJOY, a vice-president and director of the General Electric Company, who sailed from Vancouver, B. C., for Japan soon after the catastrophe, to assist in relief and reconstruction, will remain in that country for some time to promote rehabilitation, particularly of electrical projects. Mr. Lovejoy has for many years been interested in the foreign activities of the General Electric Company.

DR. JAMES N. HART, dean of University of Maine, and for the past thirty years head of the department of mathematics, has been granted leave of absence by the trustees.

D. R. HOAGLAND, associate professor of plant nutrition of the University of California, and W. Metcalf, associate professor of forestry, have been given a year's sabbatical leave of absence for foreign travel and study.

THE anniversary discourse of the New York Academy of Medicine was delivered on November 1 by Dr. William S. Thayer, of Baltimore, his subject being "Studies on acute bacterial endocarditis."

MR. GERARD SWOPE, of the General Electric Company, gave the first Aldred lecture at the Massachusetts Institute of Technology on November 9. His subject was "The engineer's place in society."

DR. S. C. LIND, chief chemist of the Bureau of Mines, addressed the Chemical Club at Princeton University on November 8 on "Are gaseous ions chemically active?"

MR. F. E. MATTHES, of the U. S. Geological Survey, gave a lecture on November 3 before the Brooklyn Institute of Arts and Sciences on "The cliffs and waterfalls of the Yosemite Valley."

THE Stamford Chemical Society, of Stamford, Conn., was addressed at their October meeting by Dr. R. B. Moore, formerly of the Bureau of Mines, who spoke on the development of the production of helium during the war and at the present time.

THE second John M. Dodson lecture of the Alumni Association of Rush Medical College will be delivered by Professor Arthur Biedl, University of Prague, in the amphitheater of Rush Medical College on November 23 at 4:30 P. M. The subject will be "The nervous and endocrine control of the functions of the alimentary tract."

DR. WILLIAM EDWARD GALLIE, of Toronto, has been appointed Hunterian professor and lecturer at the Royal College of Surgeons, London, England, for April, 1924. His subject will be "Living sutures."

DR. ARTHUR DUNN PITCHER, professor of mathematics of Adelbert College, Western Reserve University, since 1915, died on October 5.

JOHN T. HEDRICK, S.J., died at St. Andrews-on-Hudson, near Poughkeepsie, N. Y., on October 24 in his seventy-first year. He had been astronomer, and then director, at the Georgetown College Observatory for many years. Failing health obliged him to retire to St. Andrews.

GEORGE WHARTON JAMES, of Pasadena, California, known as an explorer and ethnologist, died on November 8, aged sixty-five years, at St. Helena, California.

DR. A. A. RAMBAUT, F.R.S., formerly professor of astronomy in the University of Dublin and royal astronomer of Ireland, the Radcliffe Observer at the University of Oxford, died on November 4, aged sixty-four years.

THE death is announced of Dr. P. Friedländer, privat-dozent for organic chemistry and technical organic technology in the Technical Hochschule at Darmstadt. Dr. Friedländer is well known for his investigations on the chemistry of dyestuffs and for his work "Fortschritte der Teerfarbenfabrikation," which appeared in twelve volumes.

DR. KARL FLUGGE, emeritus professor of hygiene at Berlin, has died at the age of seventy-six years. The Flügge foundation was organized in his honor on his seventy-fifth birthday.

Nature states that a movement is on foot to commemorate the late Sir Isaac Bayley Balfour. An area of 50 acres in Glenbranter Forest, Argyllshire, where the plants raised at the Botanic Garden, Edinburgh, can be cultivated under suitable conditions and where trials may be made in the rearing of newly imported conifers and other trees, has been secured for the purpose. It is proposed that the area shall be called the Bayley Balfour Arboretum or Garden, and that the memorial shall take the form of a rest-house for the use of visitors. Subscriptions towards the memorial are solicited. They should be sent to the honorary secretary and treasurer, Mr. J. Sutherland, 25 Drumsheugh Gardens, Edinburgh.

THE one hundred and twenty-third regular meeting of the American Physical Society will be held at the Ryerson Physical Laboratory of the University of Chicago, on November 30 and December 1. Other meetings are scheduled to take place as follows: December 27–29, Cincinnati, Annual Meeting; February 23, 1924, New York; April 25–26, 1924, Washington; Pacific Coast Section—place not yet determined.

ARRANGEMENTS for the Washington Meeting of the American Chemical Society have been planned definitely for the week of April 21, 1924. The council meeting will be on Monday of that week, a general meeting on Tuesday, and the following three mornings will be devoted to divisional meetings and the afternoons to sightseeing at the technical institutions in the city.

THE American Institute of Chemical Engineers is completing plans for its sixteenth annual meeting to be held in Washington, December 5 to 8.

THE Chicago Section of the American Chemical Society has originated a plan for this year whereby each section will be responsible for one monthly issue of *The Chemical Bulletin*. The Wisconsin Section will publish the November issue in cooperation with the Milwaukee, Wisconsin, Minnesota, Iowa, Ames, Louisville, Nebraska, Kansas City, Illinois, Purdue and Arkansas sections. *The Chemical Bulletin* reaches some 2,500 chemists.

DR. CARL WILHELM L. CHARLIER, professor of astronomy at the University of Lund, and director of the Lund Observatory in Sweden, will lecture at the University of California during the summer of 1924. During the Intersession, Professor Charlier will offer a course entitled, "The Motion of the Stars." In the Summer Session, which opens June 23, he will conduct a course on "The Distribution of the Stars."

THE Salters' Institute of Industrial Chemistry has awarded sixty-four grants in aid to chemical assistants, occupied in factory or other laboratories in or near London, to facilitate their further studies.

UNIVERSITY AND EDUCATIONAL NOTES

MR. MILTON S. HERSHEY, chocolate manufacturer, has placed his entire fortune, estimated at sixty million dollars, in trust for the orphanage and industrial school founded by him at Hershey, near Harrisburg, Pa., in 1909.

THE General Electric Company of New York has given $5,000 to the Cavendish Laboratory of the University of Cambridge, of which Sir Ernest Rutherford is the director, to promote investigations, and the British Thomson-Houston Company £250 for a similar purpose.

THE University of London has accepted a gift of £10,000 to found a chair of otology and the donor, Geoffrey E. Duveen, intends to allocate a further £15,000 to University College Hospital to provide for the treatment of the deaf.

MR. GEORGE BLUMENTHAL, of New York, has made a gift of 250,000 francs to the University of Paris, to be used in the best interests of science and art.

DR. LEWIS HILL WEED has been named by the trustees of Johns Hopkins University as dean of the medical school. Dr. Weed, who is professor of anatomy, succeeds Dr. J. Whitridge Williams, who recently resigned to devote his time to the women's clinic of Johns Hopkins Hospital, of which he is director.

DEAN DAN T. GRAY, of the Alabama Polytechnic Institute, has been appointed Dean of the College of Agriculture and director of the Agricultural Experiment Station in the University of Arkansas. It is expected that Dean Gray will assume his new duties about January 1.

DR. CARL R. FELLERS has been appointed associate professor in charge of the newly established department of food preservation, University of Washington.

Dr. Fellers was formerly associated with the U. S. Bureau of Chemistry and with the National Canners Association.

NORMAN W. KRASE has resigned from the Fixed Nitrogen Research Laboratory to accept an instructorship at Yale University in the department of chemical engineering.

THREE new instructors have been appointed in the geology department of the University of Michigan—Dr. Walter A. Ver Wiebe, Mr. R. L. Belknap and Miss Ellen Stevenson.

MR. M. DIXON, of Emmanuel College, Cambridge, has been appointed senior demonstrator in biochemistry for five years.

DR. WILLIAM F. SHANKS, who graduated with special distinction in physiology in the University of Glasgow, has been appointed professor of physiology at the University of Leeds.

DISCUSSION AND CORRESPONDENCE

WATER GLASS AS A MOUNTING MEDIUM

IN your issue of July 6, page 13, "water glass" is recommended as a substitute for Canada balsam as a medium for mounting objects for microscopic study. In 1870 I experimented with this substance, which at first appeared satisfactory, but after some months a host of fine acicular crystals developed in it, finally obscuring and completely ruining the slides.

WM. H. DALL

U. S. NATIONAL MUSEUM

I HAVE not used water glass in the way described by Mr. Dean T. Burk, but have been using it for years as a cement for fossils, pure or mixed with chalk or plaster of Paris. At first I found it satisfactory, being clean, drying quickly and fixing well. But after two or three years the glass changed its constitution, becoming crystalline, and the pasted objects became loose, so that I ejected it at once from my laboratory at Petrograd and never used it again.

I suggest that the same crystallization, and surely with the same sad effect, must take place in the water glass when used as a mounting medium for microscopic objects. In any case, the experience of some years is necessary to approve this method.

The use of water glass as a substitute for shellac in mounting insects on points, is, in my opinion, for the reason given above, absolutely unacceptable. If such a substitute is looked for by entomologists, I would recommend them to try the solution of some celluloid in acetone, a composition that I have used for years very successfully as a cement for fossils. This solution is just as handy as water glass, but it has not the inconvenience of the latter and can be prepared of different consistencies, an important item in many cases.

The celluloid, remaining after the evaporation of acetone, pastes together very strongly, keeps its property practically forever and in comparison with shellac is nearly colorless, unaffected by heat and does not snap off.

T. TOLMACHOFF

CARNEGIE MUSEUM

IN connection with the article by Dean T. Burk, of the University of California, in SCIENCE for July 6, I wish to call attention to an article which I published in the *Journal of Applied Microscopy and Laboratory Methods*, just twenty years ago, the exact date being July, 1903. The method is given in detail, together with its advantages and disadvantages, and at that time had been in use by myself and associates for about two years.

There are several objections to the use of water glass for mounting histological and pathological sections, the main ones being its poor clearing power and its alkaline reaction, which would have a detrimental effect on many stains. The method is of value for certain unstained preparations, notably vegetable fibers, if only moderate durability is desired.

CHARLES E. M. FISCHER

THE FISCHER LABORATORIES, INC.

FILING REPRINTS

DR. W. G. FARLOW filed his reprints in very shallow, flat drawers, laying them face up, one in a place. I began by binding mine into fairly good sized volumes with an index. Afterwards, having to consult one number in a volume repeatedly, I became weary of handling the heavy book for the sake of a tiny separate and abandoned this method. Ten or fifteen years ago I adopted one similar to that described by Edwin G. Boring in SCIENCE, October 26, 1923, and have found it very convenient and satisfactory.

Apparently the only difference is that I buy my boxes by the 5-hundred from a box maker and have the sides cut beveling at the top so that the top width of the side is 2 inches and the bottom width is 7½ inches, the lower end of the bevel running out at a height of 4 inches from the bottom of the box. The height of the box is 11 inches, the width of it, outside measurement, 3 3/16 inches, giving an inside measurement of 3 inches. On the back of each one I paste a typewritten list of the authors inside, arranged alphabetically. I write at the top of each separate, on both the front and back, the name of the author, and the object of the bevel is now apparent because when the box is pulled out the upper back corner of the separate projects out of the box. By running them over with my fingers I can see in a moment, without looking at the titles, all I have by a given

author, and whichever way I grab up the box—front or back. It is so long since I have had any of these boxes made that I do not remember the cost and, of course, that would vary with the locality and material. The boxes I have are made of good grade pasteboard, about 3/32 inch thick, covered at back and joints with black cloth. The only objection to such open boxes is dust, but if they are shut into glass-faced, unit-size, extra high, bookcase sections, the glass front lifting to a horizontal position and sliding back over the boxes, the dust difficulty is not great. Tiers of these, one above the other, enable one to see at a glance all his separates on a given subject. The units I have are about 12 inches deep, 15 inches high and each one will hold 9 of these boxes. They are known as book-case sections, outside dimensions 33 inches wide, 13 inches deep and 16¾ inches high, fitted with disappearing glass panel door with non-binding device, and were purchased from the Globe-Wernicke Co.

ERWIN F. SMITH

GERMAN SCIENTIFIC MEN AND RESEARCH

IN these sad times of political and economic depression in Germany, it is worth while to note the interest that is still maintained in research among the German scientists. The writer attended the third annual congress of the *Deutsche Gesellschaft für Vererbungswissenschaft* which met in Munich from September 24 to 27 of the present year. The meetings, which were held in the anatomical institute of the university, were presided over by Richard von Hertwig and were attended by three hundred scientists. The program was divided into three sections for the reading of papers—the botanical papers coming on Monday, the zoological on Tuesday, and the anthropological on Wednesday. For Thursday, an excursion was planned into the Tyrol.

More important to the writer than the papers read was the fact that, in such times as these, university professors were willing to spend from their salaries (about two hundred and fifty dollars a year) a sum equal to one or two weeks' income, and this at a time when the railroad fares were to be increased two and a half times before their return home. The excursion into the Tyrol was announced as fourth class on the railroad and most of those present had traveled fourth class to Munich. Black bread without butter at home, board seats on the railroad, but genetics at Munich! About one fourth of those in attendance were women, and women took part in the discussion. Among those present were such well known men as Hertwig and Goebel, of Munich; Spemann, of Freiburg; Lehmann, of Tübingen; Oehlkers, of Heidelberg; Kniep, of Würzburg; Renner, of Jena; Winkler, of Hamburg; Goldschmidt and the younger von Wettstein, of Dahlem; Buder, of Griefswald, and the elder von Wettstein, of Vienna.

F. C. NEWCOMBE

STUTTGART, GERMANY

QUOTATIONS

MINERVALS

A CONTRIBUTOR to the current number of SCIENCE named Welsh, writing from Nirvana (not the state of beatific freedom from earthly ills, but Nirvana in the State of Pennsylvania), makes reply to an earlier contributor, Professor Preston Slosson, in the matter of the meager salary of Professor Blank as compared with the income of John Smith, merchant. Professor Slosson, as protagonist for Professor Blank, shows that his client's salary can never be more than $4,500 at 60, at which age he is retired on half pay—that is, less than $2,500; while John Smith, merchant, starting at 15 years of age as an office boy at a salary which Professor Blank does not have until he is 25, is at 60 enjoying profits of $25,000 a year as a retired stockholder, or ten times the income of Professor Blank. He holds that Professor Blank's salary ought to be at least $8,000 or $10,000. Otherwise the business world can always outbid the college for the services of able men. He contends that the leisure of the college man (which is supposed to justify a smaller money stipend) is a myth, and that while the pleasantness of his occupation is undeniable, if salaries were cut down on that account some of the wealthiest men should have a like cut, since they are "hardly happy" away from their offices and would enjoy a Latin professorship even less than a Latin professor would enjoy a seat in the Stock Exchange.

Moreover, while business has its millionaires, education has none. Its "minervals" are reckoned in thousands at most. Even the authors of text-books do not rise to great wealth. The economic value to society of the research scientist of the highest calibre may be many times that of the ablest banker or railroad president, and yet he may be enjoying but a small fraction of the latter's salary (witness Dr. Steinmetz's insignificant savings of a lifetime). It would be only a fitting recognition to pay these outstanding men of science as much at least as a first-class "realtor."

Comes now Mr. Welsh, of Nirvana, and says that John Smith, merchant, is far beyond the average merchant in his income; that of those who attempt business for themselves 90 per cent. are failures and are forced to drop out with their capital completely used up; that those who succeed are the most severely selected class in the world; that the average professors should be compared not with the successful business man but with his employes, and that they get

"all they are worth to the community." He even goes so far as to assert that few of these "audible books," as he calls them, benefit the community so much as the average clerk, because "their efforts are not directed and coordinated" as are those of the clerks.

Without disparagement of merchant or clerk, it is to be remembered that it is largely by the guidance of those who perform such service as that of Professor Blank that we progress toward the true state of Nirvana on earth. If the real value of these teachers and researchers were estimated by what America would conceivably be without their intangible, spiritual contributions, not to mention what their discoveries have added to life's comfort, convenience, length and strength, their wages would be incalculably augmented. If for "Professor Blank" were written, for example, "Professor Joseph Henry," is there any salary that would be quite adequate to pay civilization's debt to this Albany schoolmaster and Princeton professor? The tinkle of the tiny bell that he first rang by electricity is soon to be heard by radio around the world. But the influence of many a professor is felt as widely. His merchandise is "better than silver." His "minervals," as his wisdom fees were called in ancient times, should, however, be sufficient to permit him to remain where he can give the highest service to the community.—*The New York Times.*

SCIENTIFIC BOOKS

Labyrinth and Equilibrium. Monographs on Experimental Biology. By S. S. MAXWELL. 163 pp., Philadelphia and London: Lippincott, 1923.

IT should be sufficient, for the purposes of most reviews, to be able to say that the book had been written by one who had actually worked at the problems discussed and who had contributed many illuminating facts in a subject which has been obscure since the first pioneer entered the field. I can say this of the volume now under discussion. The author's own work, so lucidly described in the pages of this book, has given us a clearer idea than we have had of the mechanism of stimulation of the afferent nerve endings in the non-auditory portion of the internal ear.

Goltz stated the general problem of the function of the non-auditory or vestibular portion of the internal ear nearly two generations ago. Three things are necessary: (a) The peripheral receptor and the afferent nerve; (b) the central nervous system, and, (c) the efferent nerves, together with their effectors—the skeletal and various other muscles in the case of the present mechanism. The book deals, for the most part, (a) with the relation of the labyrinth to forced or abnormal positions of the organism, and to the compensatory positions which follow the displacement of the animal from its normal position and, (b) with the general mechanism of stimulation of the vestibular endings. These phases of the subject are handled with all the clearness which our present knowledge of the subject permits.

The final chapter is on nystagmus, the peculiar ocular movements resulting from vestibular stimulation; the slow movement in one direction, say to the right, and a quick movement in the opposite direction. Nystagmus is due to some mechanism or mechanisms in the central nervous system—the second part of the problem as Goltz formulated it—and it should not be considered as a reflection upon the book to say that here the author's hand is a little less sure. Nor is it to be taken as a sign that the author is wrong when I say that he does not wholly accept some of the opinions of the reviewer. The problem of the functional organization of the nervous system is one of the most complicated and perplexing which the biologist has to face, and no one has yet given a clear and intelligible statement of the organization of the whole mechanism for the performance of any single function, nystagmus included. This should be a sufficient apology for any lack of certainty of conclusions in the author's final chapter.

Although it is not my purpose to review it here, I wish to mention another recent volume on the vestibule, written by a psychologist.[1] Maxwell's volume deals principally with the purely objective side of vestibular stimulation. Griffith deals with the subjective or psychological side of some common vestibular effects. In addition to giving the most complete bibliography of the subject of which I am aware, he has some remarks upon some common opinions of vestibular phenomena upon which neither fact nor argument has as yet made much impression.

F. H. PIKE

COLUMBIA UNIVERSITY

SPECIAL ARTICLES

A NEW PHOTO-ELECTRIC EFFECT

REFLECTION OF ELECTRONS INDUCED BY LIGHT

A STUDY of some vacuum tubes containing caesium vapor has shown a peculiar photo-electric effect. The action of white light on an adsorbed film of caesium on nickel seems to cause this surface to reflect elastically electrons which are made to impinge on it. The number of electrons that can be thus reflected is proportional to the intensity of the light.

Two nickel cylinders, B and C, open at the ends, were mounted end to end along the same axis, being but slightly separated from one another. Inside of

[1] Griffith, Coleman R.: "An historical survey of vestibular equilibration," pp. 178. University of Illinois Bulletin, XX, No. 5, 1922.

cylinder B was a small tungsten filament A, used as a source of "primary" electrons. The tube containing these electrodes was exhausted to a high vacuum and some caesium was distilled into it before sealing off. Because of the adsorbed film of caesium on the tungsten, electron currents of convenient magnitude (50 micro-amperes) could be obtained at filament temperatures below a red heat (Langmuir and Kingdon, SCIENCE, *57*, 58 (1923)).

By placing a 200-watt Mazda lamp near the tube, so that some light entered the open end of cylinder C, photo-electric effects of two kinds were observed. The *first* was the *normal* photo-electric effect due to an adsorbed film of caesium on the cylinders. If either cylinder was made 40 volts or more negative with respect to the other, a current of electrons of a fraction of a micro-ampere passed from the negative to the positive cylinder under the influence of the light. By varying the voltage on the lamp it was found that this photo-electric current was proportional to the intensity of the yellow component of the white light (6000 A°). The photo-electric current was only cut down to about 1/10th by interposing a piece of deep red glass.

The *second* effect produced by light was observed only when B and C were both at positive potentials with respect to A and the filament A was heated sufficiently to emit electrons. The effect was manifested by an electron current flowing to C (through the space) which could not be accounted for by the normal photo-electric effect and which continued to flow to C even when the potential of B was much higher than that of C.

TYPICAL PHOTO-REFLECTION DATA

Tube at Room Temperature

E_C=100 volts E_B=60 volts I_A=21.8 microamperes

Volts on Lamp	Light Intensity	Current to C micro-amperes	Normal Photo Effect micro-amperes	Photo Reflection micro-amperes
V_L	L	I_C	I_N	Δ
0	0	0.14	0.000	0.00
40	5	0.18	0.000	0.04
50	18	0.28	0.001	0.14
60	50	0.52	0.002	0.38
70	98	0.87	0.005	0.72
80	172	1.21	0.010	1.06
90	266	1.26	0.016	1.104
100	385	1.28	0.024	1.116
110	540	1.30	0.037	1.123
120	730	1.32	0.055	1.125
130	960	1.36	0.103	1.12
140	1200	1.39	0.130	1.12

Typical data illustrating this effect are given in the table. The cylinders B and C were maintained at potentials of 60 and 100 volts respectively, these being measured from the filament A. This filament was heated to such a temperature that the emission from it was 21.8 micro-amperes.

Since this total emission was always uninfluenced by the amount of light entering the tube, the observed effect is not due to any variation in the electron emission from the filament. The light, however, did cause a change in the distribution of the current between the two cylinders, as indicated by the data in the third column, which gives the current to the cylinder C. In the absence of light a current of only 0.14 micro-amperes of electrons flowed to C, while the remainder flowed to B. This small current to C was, however, due to electrons reflected from the surface of B rather than electrons coming directly from the filament.

The first column gives the voltage applied to the Mazda lamp whose rated voltage was 120. The second column gives in arbitrary units the relative light intensity of wave length 5300 A°, calculated from the filament temperature by Wien's law for radiation.

It is seen that the current to C increased with the intensity of illumination at first rapidly, but then approached a nearly constant limit. A part of this current, however, is due to normal photo-electric current. Column 4 gives the current I_N to the electrode C, due to this normal effect. This was observed by lowering the filament temperature to any point lower than that at which it ceased emitting electrons.

Column 5 contains the quantity $\Delta = I_C - 0.14 - I_N$, which is that part of the *increase in current to C which is caused by light and which can not be accounted for as a normal photo-electric effect.*

This increase in current Δ varies at first in proportion to the light intensity L, but then becomes constant while the light intensity increases from 385 to 1200.

A large number of such runs were made with this tube, varying such factors as the voltages on B and C, the temperature of A, and the bulb temperature, and, therefore, the vapor pressure of caesium. The effect of transverse and longitudinal magnetic fields was also studied.

The results indicated that *below a certain light intensity,* which, however, varied with the conditions, *the quantity Δ is proportional to L, and in this range the ratio of Δ to L is entirely independent of the voltages on B and C, the electron emission from the filament, the bulb temperature or the presence of a magnetic field.*

On the other hand, with light intensities *above a certain limit* (not much greater than the limit previously referred to), *the quantity Δ is independent of L, but depends on each of the factors already enumerated.*

Thus by plotting Δ against L a family of curves is obtained which has as an envelope a straight line passing through the origin. If the light intensity is kept constant and the electron emission from A is increased from 0 to a large value, Δ increases at first with the emission (with the 1.6*th* power of it in one set of experiments) and then becomes constant when Δ/L has reached its limiting value.

These relationships are in many ways analogous to those in electron tubes where the current is in general limited either by emission from the cathode or by space charge, depending upon which limit has the lower value. Similarly, we may assume that the photo-electric reflection may be limited either by the number of electrons that strike the electrode, or by the amount of light reaching the electrode.

Although all the characteristics of this effect are not yet understood, it seems safe to assume that the effect is caused by an activation of an adsorbed caesium film by light, the atoms in this film being brought to such a state that they cause the impinging electrons to make elastic collisions.

The effect disappears if the voltage of either B or C is brought to zero. When the voltage E_C is less than E_B the normal photo-electric effect reverses in direction, but Δ *does not do so. The limiting value of* Δ for sufficiently high values of L, which we may call Δ_L, is greatest when E_C is considerably larger than E_B. Thus with $E_C = 100$, $E_B = 60$, and $I_A = 26$, Δ_L had a value 2.9, while for $E_C = 20$, $E_A = 100$, and $I_A = 47$, Δ_L was 0.07. The fact that the effect still existed under the latter conditions proves that several per cent. of the electrons which are reflected from B lose not more than 20 per cent. of their energy.

With E_B kept at 20 volts, Δ_L was 1.4 for $E_C = 20$, and it steadily increased as E_C was lowered below this point, until, at $E = 5$ volts, there was a sharp maximum ($\Delta_L = 3.3$). Another even greater maximum of $\Delta_L = 4.2$ occurred at $E_C = 1.1$ volt. At $E_C = 0.5$ volt the effect fell abruptly to zero.

A sharp distinction between the new photo effect, measured by Δ, and the normal effect I_N, is that the new effect disappears entirely if a piece of red glass is interposed in front of the light source, Δ falling at least to 1/1000th of its original value, whereas the normal effect decreases only to about one tenth. It is probable that the effect is mainly due to light having a wave length of about 5300 A° (blue-green).

A similar activation of a nickel surface causing electron reflection has also been found in connection with some measurements of the distribution of velocities of electrons in the positive column of the mercury arc, by a method like that described recently for measuring positive ion currents. (Langmuir, Science, *58*, 290 (1923)). By introducing high speed electrons (40 volts) into the mercury arc by means of a heated negatively charged tungsten filament, it was found that the ability of a small collecting electrode (1 sq. cm area) to take up low speed electrons was greatly impaired.

Irving Langmuir

Research Laboratory,
General Electric Company,
Schenectady, N. Y.

THE ABNORMAL REFLECTION OF X-RAYS BY CRYSTALS

In recent papers[1] we have described experiments which show that under certain conditions a crystal of potassium iodide deflects x-rays in a way that does not obey the ordinary laws of x-ray reflection. The discovery and extensive study of these abnormal reflections, called x-peaks, were made by means of ionization spectrometers. A number of experiments demonstrated that the x-peak reflections vanished when the voltage fell below the critical voltage required to produce the K series lines of iodine. From this we conclude that the abnormally reflected rays consisted of the characteristic line spectrum excited by the primary x-radiation in the iodine atoms of the reflecting crystal itself. The angle of reflection from the crystal depended in a complicated way upon the angle of incidence of the primary rays, and the phenomenon can not be regarded as ordinary reflection from any single set of crystal planes. We took special care to prevent rays regularly reflected by the various sets of planes from entering the ionization chamber.

We published in the *Journal* of the Optical Society (*l.c.*) the reproduction of a photograph taken in such a way as to show the x-rays defracted by the crystal of potassium iodide. The primary x-rays in this case passed through the crystal parallel to an axis. Four spots, in addition to that due to the direct beam of x-rays, appeared on the photograph in positions corresponding with the data obtained for the x-peaks by the ionization spectrometer. Thus the existence of the x-peak reflection was confirmed by the photographic method.

A letter from the Geophysical Laboratory has appeared in Science recently (July 20, p. 52) written by Mr. R. W. G. Wyckoff, in which he briefly describes experiments with a potassium iodide crystal and a photographic plate. The very excellent copies of these photographs, which he has been kind enough to send us, show no spots that can be attributed to the abnormal x-peak reflection. We thought it best to delay comment on this letter until we could make

1 *Proc.* Nat. Acad. Sci., 8, 90 (1922); 9, 131 (1923); *Jour.* Optical Soc., 7, 455 (1923).

an effort to ascertain what the important differences really are between Wyckoff's experiments and our own. This we have not been able to do until very recently, because we did not wish to interrupt other researches already in progress.

We have reinvestigated the x-peak phenomenon both with the ionization spectrometer and by means of photographs, and the results completely confirm our previous conclusions. At least one of these photographs with a detailed description of the apparatus will be sent for publication in a future paper. The photographs show a large number of Laue spots reflected in the ordinary way from the various crystal planes together with the four well-defined spots that can not be reflected from any conceivable planes in the crystal and which correspond exactly in position with the x-peak reflections. On one of these photographs no spots except the central image are more strongly marked than those representing the x-peak reflections. There can be no doubt as to the reality of these abnormal reflections of the rays by the potassium iodide crystal.

Mr. Wyckoff's experiments are similar to the original experiments of Laue, Freidrich and Knipping, performed eleven years ago. These have been repeated over and over again by many scientists. It is not likely that such experiments would bring out the abnormal x-peak reflections in any reasonable length of time, for, if they did, the abnormal reflections probably would have been discovered long ago. The first experiments that we, ourselves, performed with photographic plates were more or less of the same kind, and in these we did not get evidence for the x-peak reflection. It was only by modifying the experiments that we succeeded in getting this photographic evidence after many hours of exposure.

As the x-rays deflected by the crystal can be detected and measured easily in a few seconds of time by their ionizing effects, this indicates the very great analyzing power of the ionization method as compared with the photographic for certain purposes.

The important differences between our experiments and the ordinary Laue photographic experiments appear to be as follows:

(*a*) Mr. Wyckoff applied to the x-ray tube an alternating voltage with a peak value of approximately 50,000 volts. It required at least 33,000 volts to produce the characteristic radiation of iodine. In our experiments we employed a voltage of 75,000 volts, more than twice as far above the critical voltage of iodine as that used by Wyckoff. Further, our voltage was constant, and did not fluctuate with the time. The fact that the voltage remained at 75,000 all the time means that our primary x-ray beam was far richer in short x-rays, the kind of rays that produce the iodine line spectrum most effectively, than was the alternating voltage employed by Wyckoff. The difference in power of producing the characteristic radiation of iodine between a constant voltage of 75,000 volts and an alternating voltage of 50,000 volts is very great.

(*b*) In the experiment which gave us our best photographs we used a single pin hole in a lead sheet to define the beam of x-rays incident on the crystal. Thus, the cross-section of this beam was determined by the area of the pin hole and that of the focal spot on the target of the x-ray tube. Further, the target of the x-ray tube was so placed that the rays passing through the pin hole almost grazed the target's surface on leaving it. This arrangement greatly increases the intensity of the x-radiation passing through a small opening. We have also made experiments with two pin holes to define the incident beam, the arrangement ordinarily used in taking Laue photographs and the arrangement which Mr. Wyckoff employed. We found that the intensities of all the spots on the photographic plate were somewhat reduced by inserting this second sheet of lead with a pin hole in it, but the intensities of the spots representing the x-peak radiation were reduced in a very much greater ratio than the others, so that employing two pin holes to define the beam decreases the photographic effect of the x-peak radiation as compared with that of the ordinary reflection. This phenomenon is quite marked. It undoubtedly is due to the fact which we have mentioned several times, namely, that the characteristic reflection of x-rays is not as accurate a phenomenon as the ordinary reflection of x-rays. In the case of the ordinary reflection only those rays of given wave-length that are practically parallel to a given line are reflected by a given set of planes. In the case of the reflection of the characteristic rays, the direction of the incident beam does not have to be so accurately parallel to the given line.

(*c*) We used a somewhat thicker crystal of potassium iodide than that employed by Wyckoff. As the characteristic wave-lengths of iodine lie in the portion of the spectrum for which iodine is most transparent, this means that our crystal let through a larger proportion of characteristic rays as compared with other rays than was the case in Mr. Wyckoff's experiments.

As stated in our papers, we have observed other anomalous deflections of x-rays by a crystal much weaker than the x-peak reflections. Dickinson[3] has recently detected similar anomalous deflections by the photographic method. He explains his results by assuming that they are due to reflections by "small crystals individually perfect but with their axes slightly inclined to those of the main crystal." This hypothesis does not explain the strong x-peak reflec-

[3] *Physical Review*, Aug., 1923, p. 199.

tions, for one can not deduce from it the observed characteristics of the x-peak phenomena—such, for instance, as the way in which the angle of reflection depends upon the angle of incidence of the primary beam, the appearance of only one x-peak in each quadrant and the fact that the critical voltage is always about equal to that of the K series of iodine. The influence of the critical absorption of the chemical elements in the crystal has been indicated on many of our published diagrams.

It is evident from the above-mentioned experiments that all the possible reflections of x-rays by a crystal such as potassium iodide have not yet been thoroughly examined. The possibility of abnormal reflections has a direct bearing upon the analysis of crystals by means of x-rays, especially upon those methods of analysis which require the taking of Laue photographs. For a completely satisfactory analysis of crystals by such a method it would be necessary to determine what the wave-length of the various deflected beams are. Probably no mistakes would be made in analyzing crystals of simple forms, such as cubic crystals, but in the more complicated cases the fact that abnormal reflections occur must always be borne in mind and in case of doubt the wave-lengths of the deflected beams should be determined. It would be difficult to measure the critical voltages for these deflected rays by the photographic method, but they could be easily determined by an ionization spectrometer.

Harvard University

George L. Clark
William Duane

THE AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE

MEETING OF THE EXECUTIVE COMMITTEE

The meeting was called to order in the board room of the Cosmos Club, Washington, at three o'clock on the afternoon of October 14 with the following members present: Cattell, Fairchild, Howard, Humphreys, Livingston, Osborn, Walcott, Ward. The following were absent: Flexner, MacDougal, Noyes. President Walcott was elected chairman. The minutes of the last meeting were approved as previously circulated. The following interim minute of action by mail was approved: September 17, 1923. On nomination of the section committee of Section M, Mr. John T. Faig was elected to be vice-president for Section M and chairman of the section for the current year.

The permanent secretary's report on the affairs of the association was presented in mimeographed form, and was accepted. The permanent secretary's annual financial report (of September 30, 1923) was presented and accepted, and it was ordered to be audited and presented to the council at the next annual meeting.

The treasurer's report was presented by Mr. John L. Wirt, who was present by invitation. It was accepted and ordered to be audited and brought before the council at the next annual meeting.

An appropriation of $4,500 was voted for grants, including the recent Newcomb Cleveland gift of $500.

The permanent secretary reported that the project of starting a quarterly publication, to include the preliminary announcement of the annual meeting, has been postponed for the present on account of uncertainty as to funds.

The permanent secretary reported that the special committee on the philological sciences is active and that a program on this subject will be presented at the approaching Cincinnati meeting.

The appointment of Dr. Charles A. Shull, of the University of Chicago, to be assistant secretary of the association in the place of Dr. Sam F. Trelease, resigned, was approved. This appointment is for the period from September 1, 1923, to the end of the Cincinnati meeting.

The sponsorship, by the association, of the project on the standardization of engineering and scientific abbreviations and symbols was approved. The association becomes sponsor, along with the U. S. Bureau of Standards and the Society for the Promotion of Engineering Education, for the preparation of a system of standardized symbols, etc., without any financial obligations on the part of the association. The association reserves the right to pass upon the recommendations of the joint committee, when finally made, and, for its own part, to approve or disapprove, in whole or in part. The special committee which represents the association in this work consists of Dr. Henry N. Russell, of Princeton University, chairman; Dr. Augustus Trowbridge, of Princeton University, and Dr. E. W. Washburn, of the National Research Council.

The question of further publicity for the resolution on Pueblo Indian lands (adopted April 22, 1923) was left to the general and permanent secretaries, with power. The resolution has been widely published and a supply of printed copies is available at the permanent secretary's office.

One hundred and twenty-six fellows were elected, distributed among the sections as follows: Section D, 1; Section M, 12; Section O, 112; Section Q, 1.

It was voted that the permanent secretary call a meeting of the executive committee on the evening of Wednesday, December 26, at Cincinnati, if, in his judgment, there are matters for consideration that may not be cared for satisfactorily at the forenoon meeting on the following day.

After the reading of communications from the

British Association for the Advancement of Science, which evidenced the approval of that association, it was voted that the American Association for the Advancement of Science shall hold a summer meeting at Buffalo, preceding the Toronto meeting of the British Association to be held in September, 1924.

The following resolutions were adopted, regarding the permanent endowment of the association and the income therefrom:

(1) *Resolved:* That an assistant treasurer of the association be appointed, to serve till the end of the next Washington meeting, whose duties shall be to assist the treasurer.

(2) *Resolved:* That checks drawn upon the authorized account of the association in the Fifth Avenue Bank, of New York, be signed by the treasurer or assistant treasurer and countersigned by the president or the permanent secretary of the association.

(3) *Resolved:* That the treasurer or assistant treasurer be authorized to open an account with the American Security and Trust Company, of Washington, in the name of the American Association for the Advancement of Science with instructions that checks on this account be signed by the treasurer or the assistant treasurer and countersigned by the president of the association or the permanent secretary.

(4) *Resolved:* That the Finance Committee shall consist of the treasurer and assistant treasurer and three members to be elected by the Executive Committee, one each year for a term of three years.

(5) *Resolved:* That the Finance Committee shall have custody of the securities of the association and general charge of its investments and invested funds, with power to sell and deliver any securities belonging to the association whenever occasion may arise to do so; and the president and treasurer, or assistant treasurer, of the association are authorized, with the approval of said committee, to execute any necessary instrument or instruments of transfer and to affix the corporate seal of the association thereto.

(6) *Resolved:* That all moneys appropriated for use under allotments to be made by the Committee on Grants and not used during the calendar year for which the appropriation has been made, shall revert to the treasury at the end of that calendar year. (Appropriations are generally made at the annual meeting, at the beginning of the calendar year. Allotments are made by the Committee on Grants, and disbursements are made by the treasurer's office in accordance with directions from the Committee on Grants. If an allotment be made and accepted by the grantee and the latter wishes not to draw the funds—or to draw only part of them—within the calendar year for which the appropriation was made, such an allotment is to be considered as used within the calendar year. When a grant is not accepted or is returned by the grantee, the Committee on Grants may re-allot it to another grantee, as of the same calendar year, but no funds appropriated for use under allotments by the Committee on Grants during any year and not accepted by the grantees during that year are to be available for allotment and disbursal in the succeeding year unless again appropriated for the latter year.)

In accordance with resolution 1, above, Mr. John L. Wirt was elected assistant treasurer of the association, his term of office to expire at the close of the Washington meeting of 1924.

The executive committee voted that the permanent secretary write a note of sympathy and condolence to Mrs. R. S. Woodward, on account of the protracted illness of Dr. Woodward.

It was voted that the annual meeting for 1926 shall be held at Philadelphia, the dates being, according to the adopted schedule, from Monday, December 27, 1926, to Saturday, January 1, 1927. Future annual meetings thus far decided on are as follows:

1924, Cincinnati: Thursday, December 27, 1923, to Wednesday, January 2, 1924.
1925, Washington: Monday, December 29, 1924, to Saturday, January 3, 1925.
1926, Kansas City: Monday, December 28, 1925, to Saturday, January 2, 1926.
1927, Philadelphia: Monday, December 27, 1926, to Saturday, January 1, 1927.
1928, ——————: Monday, December 26, 1927, to Saturday, December 31, 1927.
1929, New York: Thursday, December 27, 1928, to Wednesday, January 3, 1929.

A request for exchange of publications was received from the Staats- und Universitätsbibliothek of Hamburg, and the permanent secretary was authorized to send to that library the Proceedings volumes.

A communication (October 10) and an offer were received from a member of the association, concerning the awarding of a prize for scientific achievement in 1924, and the offer was accepted with thanks. The donor is to remain unnamed. A special committee was appointed to consider and provide arrangements for carrying out the terms of the offer. This committee consists of the president, the permanent secretary, and Dr. Cattell, the last being chairman.

It was decided that the section secretaries be invited to be the guests of the association, to meet the members of the executive committee, at a dinner to occur on Sunday evening, December 30, at Cincinnati, the dinner to be preceded and followed by conferences on the affairs of the association.

It was voted that the Saturday evening session at Cincinnati (December 31, 1923) shall be devoted to a series of brief talks by past presidents of the association and the permanent secretary was instructed to invite all living past presidents to take part. This session is planned specially in celebration of the seventy-fifth anniversary of the founding of the association.

It was voted that the collection of photographs of

the presidents of the association be exhibited at the Cincinnati meeting.

The meeting adjourned at 10:30.

BURTON E. LIVINGSTON,
Permanent Secretary

MEMBERSHIP IN THE ASSOCIATION

ON September 30, 1923, the total enrollment was 11,704. There were 376 life and sustaining members and 10,411 annual members in good standing, making a total of 10,787 members in good standing. The names of 407 in arrears for two years and those of 510 in arrears for one year remained on the roll. On October 1 the 407 were dropped from the membership list, as is ordered by the by-laws. The corresponding number of names dropped October 1, 1922, was 455. The total enrollment was 11,297 at the beginning of the present fiscal year (1924), of which 10,380 represents the total membership in good standing. On October 1 the annual dues for the fiscal year 1924 become due. The growth of the association for the period since September 30, 1920, is shown by the following tabulation:

	Sept. 30, 1920	Sept. 30, 1921	Sept. 30, 1922	Sept. 30, 1923
In good standing	10,002	10,160	10,566	10,787
Total enrollment	11,442	11,547	11,646	11,704
New life members for the year just ended	22	12	15	27
New members and reinstatements for year just ended	......	922	1,253	874
Died during year just ended	......	......	87	91
Resignations for year just ended	......	386	362	270
Dropped at beginning of year just ended	......	387	705	455

The net gain in total enrollment for the fiscal year 1923 is only 58, but the corresponding net gain in membership in good standing is 221, which is not at all discouraging. Moreover, 27 new life members were enrolled in 1923, an unusual gain. At the end of the fiscal year 1921, 88 per cent. of those on the roll were in good standing. The corresponding percentage at the end of the fiscal year 1922 was 91 and that at the end of 1923 was 92.

BURTON E. LIVINGSTON,
Permanent Secretary

THE LOS ANGELES MEETING

III

THE AMERICAN CHEMICAL SOCIETY

Joint Meeting of the California Section and the Southern California Section held in conjunction with the Meeting of the Pacific Coast Branch of the American Association for the Advancement of Science, September 19, 1923, in Los Angeles.

The determination of calcium: WM. C. MORGAN. Calcium precipitated as oxalate and determined by titration with permanganate always gives results about one per cent. lower than when determined by the gravimetric method.

Critical solution temperatures: G. ROSS ROBERTSON.

A study of pressure and temperature effects on petroleum emulsions: LAIRD J. STABLER.

Butyrin: L. S. WEATHERBY. A study of the yields in the synthesis of butyrin. The conditions under which maximum yields were obtained were determined, together with some of the physical constants of pure butyrin.

The vapor pressure of monatomic elements: R. H. MILLER.

A system of qualitative analysis, including the rare elements: A. A. NOYES and W. C. BRAY. Presentation of the results of many years work upon the improvement and simplification of the system of qualitative analysis, with special reference to the detection of small amounts of rare elements in the presence of large amounts of other substances.

Dissociation of hydrogen cyanide at high temperatures: R. M. BADGER.

The rate of dissociation of sulphuryl chloride: D. F. SMITH.

Studies on the chemical behavior and the chemical properties of insulin: G. A. ALLES and A. L. RAYMOND. Report upon the improvement in the methods of preparing and testing insulin.

Some new experiments on the oxidation-reduction theory of contact catalysis: A. F. BENTON and P. H. EMMETT.

New studies in nitrogen fixation: C. B. LIPMAN. (By title.)

Present status of chemical criteria in soil fertility investigations: J. BURD. (By title.)

MARK WALKER
Secretary, Southern California Section, American Chemical Society

SEISMOLOGICAL SOCIETY OF AMERICA

THE Seismological Society of America held a meeting in one of the buildings of the University of Southern California at 2 P. M. on Tuesday, September 18. Second Vice-president Harry O. Wood presided at the meeting.

Two papers were presented, "A proposed research into the possibilities of earthquake prediction," by Ernest A. Hodgson (read by the secretary), and "Can tectonic causes explain Nigger-Bixby and Balboa sloughs?" by Oscar Stromborg. Mr. Wood gave a brief account of the Fault Map of California recently published by the Seismological Society.

S. D. TOWNLEY,
Secretary

SCIENCE

VOL. LVIII NOVEMBER 23, 1928 No. 1508

CONTENTS

SCIENCE: A Weekly Journal devoted to the Advancement of Science, edited by J. McKeen Cattell and published every Friday by

THE SCIENCE PRESS

Lancaster, Pa. Garrison, N. Y.
New York City: Grand Central Terminal.

Annual Subscription, $6.00. Single Copies, 15 Cts.

SCIENCE is the official organ of the American Association for the Advancement of Science. Information regarding membership in the association may be secured from the office of the permanent secretary, in the Smithsonian Institution Building, Washington, D. C.

Entered as second-class matter July 18, 1923, at the Post Office at Lancaster, Pa., under the Act of March 3, 1879.

THE CONTRIBUTIONS OF ASTRONOMY TO CIVILIZATION

THE principal duty imposed upon the president of the Pacific Division is the delivery of an address at the annual meeting. In some respects this duty is an embarrassing one for the present incumbent. This is preeminently an astronomical occasion, and your president is not an astronomer. With no original message of his own, he can perhaps best fulfill his obligations by reminding those who are gathered here of some of the great contributions which astronomy has made to civilization.

If the earth were alone in the universe human life could not exist. With the sun to give essential warmth and light, life would be possible; but imagine if you can how the progress of mankind would have been retarded if there were no stars, or if the pioneers of astronomy had failed to discover how to use their apparently uniform rotation as a measure of the flow of time and the axis of this rotation as a standard of direction. The north star was a faithful guide to the traveler, and without it Columbus might well have hesitated to embark on his perilous journey in search of a new world. The first astronomers, without instruments, must first have noticed the rotation of the fixed stars about the axis passing through Polaris, then the orderly annual precession due to the motion of the earth in its orbit. The seemingly erratic motions of the planets must have puzzled them, but in time the orderly sequence of their motions with respect to the earth was recognized and correctly described in Ptolemy's theory of epicycles. As time went on, accumulated observations and deductions therefrom gradually made clear our relations to the solar system. Copernicus revived the bold guess made by others centuries before, that the earth and planets revolve about the sun. Galileo, with the enlarged field of vision due to the telescope, found reasons to support that guess, and Kepler formulated the laws which almost exactly describe the motions of the planets in elliptic orbits around the sun. Newton proved that the same force which causes bodies to fall to the earth, causes the moon to revolve about the earth and the earth about the sun. This discovery made celestial mechanics an exact science.

Mathematical astronomy has made it possible to establish standards of time and to make exact surveys of the earth, and enables the navigator to find his position and determine his direction at sea. When his observations are made impossible by cloud or

fog and he is compelled to rely upon the uncertain aid of compass and log, the sailor realizes what he owes to astronomy.

In making an exact chronology and exact surveys of the earth possible and in facilitating maritime intercourse between nations, astronomy has rendered a practical service which all must recognize, and which is of inestimable value to civilization. But civilization means more than material welfare. It means the extension of man's range of thought beyond his immediate surroundings and the constant effort to discover his relations with the universe; it means an understanding of the phenomena of nature on this earth and in all the heavenly bodies accessible to our sight; it means the projection of our mental vision backward to the remote past and forward into the distant future; it means an understanding not only of the evolution of man and of society, but of the evolution of worlds; it means the formulation of a consistent hypothesis regarding time and space and their relation to each other, and it means a constant effort to develop the esthetic and spiritual values of life, which must be closely associated with the physical phenomena which affect our lives and thoughts and which are the direct objects of scientific study. It may mean other things as well, but to all of these elements of civilization at least astronomy has made notable contributions, and upon it alone must we depend for our knowledge of what lies outside this tiny atom which we call the earth.

By successive steps Ptolemy, Copernicus, Kepler and Newton made clear the relations of the earth to the solar system. Later observations on the orbits of double stars showed that the law of gravitation holds good to the remotest regions visible through the telescope. The spectroscope shows that the sun and the stars are made of the same materials as the earth, *thus proving the material unity of the universe.* The spectroscope and the telescope have enabled us to extend our observations to any heavenly body from which light brings its message, and slowly but with increasing certainty the astronomer is learning to interpret these messages and to journey in imagination to far distant worlds.

The spectroscope tells us how fast the stars are moving in the line of sight with respect to the earth, and by analyzing such results, Campbell and others are able to tell us how rapidly and in what direction the solar system is traveling through the stars. Furthermore, spectroscopic observations, interpreted with the aid of researches made in the physical laboratory, give definite information concerning not only the constitution, but also the temperatures and the densities of stars. The angular diameters of many stars have been determined by Michelson's interferometer method, and in cases where the distances are known the actual diameter can be calculated. So far away are they that only in comparatively few cases can their distances be determined by triangulation, using the diameter of the earth's orbit as a base line, but Adams has shown how we may determine their distances, no matter how great these distances may be, from definite and easily observed relations between their apparent brightness and the peculiarities of the lines of their spectra.

Through the action of gravitational forces, heat and chemical and radioactive transformations, every body in the universe is undergoing ceaseless change. If we can in the case of any one body discover its original condition and establish the sequence of its physical states until its life of physical activity has run its course, the problem of stellar evolution is solved, for we may be sure, from the substantial identity of constitution of all the heavenly bodies, that they will all pass through the same cycle of experience. The human race can not exist long enough to follow the life history of any one star, but from the study of individuals in different stages of development, we can, with the aid of established physical principles, infer the sequence of their stages of development.

To Kant and to Laplace we owe the first rational hypothesis of stellar evolution, but they had at their command insufficient data to establish their nebular hypothesis on a sound basis. Within the last few years astronomers have accumulated a great mass of material which gives a more secure foundation for a consistent theory of stellar evolution. In the case of hundreds of stars much is known concerning their distances, their sizes, their densities and their temperatures. From the laws of physics we know the general trend of the changes which must take place in any star. If at first it is a highly rarefied and diffuse mass of vapor at a low temperature, gravitational forces will cause its gradual condensation, and this will produce an elevation of temperature, just as the air in an automobile tire becomes hot as it is compressed. As the temperature rises, the vapor will first become red hot and ultimately white hot. After the density reaches a certain stage, condensation will proceed more slowly. When the loss of heat by radiation exceeds that produced by compression, the star will cool in reverse order from white to red heat. After it has contracted to the solid state, like the earth, the production of heat by condensation will cease, while cooling by radiation will continue, until the star loses its luminosity. This process of condensation and cooling will be extremely slow, and Eddington has pointed out that it may be prolonged by internal development of heat due to superchemical transformations made possible by enormously high temperatures and pressures. These may cause the formation of one element from another by the aggre-

gation of atoms, a reversal of the radioactive process of disintegration. If such be the sequence of changes in any star, it is evident that it must pass through the red stage twice, the first time while rising in temperature toward the white state and again while cooling. It is an established fact that there are many huge dark nebulae which may be the original stuff of which stars are made, and that the red stars can be separated into two well defined classes of giants and dwarfs, differing enormously in size and density but little in mass. These large differences in size are not found in the white stars, which are all, according to this hypothesis, in the same stage of development. It is mainly to Russell that we owe this hypothesis of stellar evolution from a dark diffuse nebula passing by condensation through the giant red stage to the white stage, then back to the dwarf red stage, ultimately to become a dark solid body. This theory, while not entirely free from criticism, is a beautiful and logical picture of stellar evolution. What may be the final destiny of the dark bodies which are the final product, we can only guess. Hundreds of thousands of such dead and invisible worlds must exist, most of them perhaps destined to wander through space for all time, but some of them may, by collision with other bodies, be again resolved into glowing vapor and begin a new cycle of existence.

The distances and the magnitudes of the stars and the duration of their stages of development are beyond the grasp of human imagination. On the other hand, recent developments in physics show that in all probability every atom is the analogue of our solar system, with electrons revolving like planets around a central nucleus charged with positive electricity, in orbits so small and in periods so short as again to elude our imagination. The one element that we can grasp in comparing an atom with the solar system is the relation of the parts of each to the whole, not the absolute values of the magnitudes and the periods of time in each.

The idea of relativity, first applied by Newton to motion and extended by Einstein to include all the relations of space and time and matter, is one which is perhaps destined to exert a greater influence upon thought and conduct than the idea of evolution, and it is to astronomy that we must look for the final tests of its validity.

Newton clearly conceived the idea of relativity of motion as we actually observe it, although he believed that in fact there might be in the universe some fixed point of reference, if we could only find it. We may measure the velocity of a body with respect to the earth, but the earth itself revolves on its axis and at the same time moves around the sun. The latter is not at rest with respect to any other body, and the stars travel in chaotic fashion. If we consider the earth to be at rest, the planets move around it in epicycles. If we take the sun as the fixed center, the planets move around it in ellipses. We have no means of knowing, or even of imagining the true orbits of these bodies in space. Newton expressed the belief that "absolute space, by virtue of its own nature and without reference to any external object, remains the same and is immovable." Although many held to this view up to our time—perhaps some still do—there seems to be no way by which the absolute motion of bodies through this immovable space can be determined. For a time, however, the general acceptance of the wave theory of light revived the hope that such absolute motion might be detected. The waves with which we are most familiar, such as those of water and sound, are periodic displacements in a continuous medium, and it seems impossible to imagine any waves without some medium through which they may be propagated. This gave rise to the hypothesis of a universal ether, the medium of light waves and electro-magnetic phenomena. Various attempts have been made to determine the motion of the earth through this hypothetical stationary ether, the most famous and significant of which was the Michelson-Morley experiment, first performed nearly forty years ago and repeated several times, always with a negative result.

To illustrate the effects which might be expected, let us consider a familiar example of wave motion, that of sound, which is transmitted through the atmosphere. In 1915, from my home in Berkeley, I could see the flash of fireworks in the Exposition grounds in San Francisco, and from 49 to 54 seconds later the sound of the explosion could be heard. The difference in time was due to the varying direction of the wind. The velocity of sound in the air was in each case the same, but the air itself was transported with the wind, sometimes toward me, sometimes in the opposite direction. The apparent velocity of the sound was the resultant of these two velocities. Similarly, if an observer is stationed on a moving train, the velocity of sound waves through the fixed atmosphere appears to him to be greater if the train is moving toward the source, less if it is moving away, and since the velocity of the sound waves in the stationary atmosphere is known, the velocity of the train with respect to the atmosphere can be calculated. Similarly, if light waves are propagated in a stationary ether, and if the earth moves with respect to the ether, we would expect the measured velocity of the light to vary with the direction of motion of the earth in such a manner that the motion of the latter with respect to the fixed ether could be calculated.

The Michelson-Morley experiment, carried out with the utmost precision, showed that in all positions of the earth in its orbit the observed velocity was the

same, both in the direction of the earth's motion and at right angles to this direction. It was thus proved that the velocity of light appears to be the same to all observers, whatever may be their velocities relative to each other or to the earth. We are forced to the conclusion that it is impossible to determine uniform absolute motion through space by any optical method, and no other method can be imagined.

The experimental conclusion that the velocity of light is the same for all observers, regardless of their relative velocities or directions of motion, a fact so utterly at variance with results observed in the analogous case of sound, seems, from the standpoint of our experience, to be a logical contradiction. In seeking for an explanation, we are driven to the conclusion either that the motion produces a change of length in our apparatus and measuring instruments in the direction in which they move or that the perceptions of space and time are different for observers moving relatively to each other. The first of these alternatives was suggested by Fitzgerald and elaborated by Lorentz. The failure of the Michelson-Morley experiment could be accounted for if the dimensions of the apparatus used were shortened in the direction of the motion of the earth. This seems a plausible suggestion, because we know that a material object moving through the air would be slightly shortened in the direction of the motion by air pressure. In the latter case, however, a steel bar would be shortened less than a wooden bar, whereas Michelson and Morley used a number of materials in their apparatus, all with like result. It would, moreover, be a strange coincidence if the contraction should in every case, for all velocities and for all substances, be exactly of the magnitude to produce compensation.

Einstein in his earlier special theory of relativity sought a more general explanation which leads to the surprising conclusion that there is nothing absolute in our measurement of space and time intervals, but that they will be different for two observers moving with uniform velocity with respect to each other. A fundamental postulate of classical mechanics is that the time interval between two events and the distance between two points in a rigid body are the same whether measured in the system to which they belong or observed from another point of reference moving with respect to the first. All our measurements of time and space depend directly or indirectly upon the use of light signals, and hence will be dependent upon the facts that the velocity of light is finite and its apparent velocity the same for all observers. These measurements depend upon sense perceptions which may not correspond to the real world in any absolute sense. It is not possible here to enter into a detailed discussion of this subject, but Einstein showed by simple and irrefutable algebraic calculations that if an observer regards himself as at rest, the dimensions of objects and the durations of events in a system moving relatively to him will appear to be changed. For example, if the aviator in a rapidly moving aeroplane waves his arm, it will appear shorter when in the horizontal than in the vertical direction, and the duration of the gesture will appear to increase with the speed of the aeroplane. The aviator is not aware of these changes; on the contrary, to him objects on the earth appear to be shortened and intervals of time lengthened. In each case, the calculated expression for the shortening is identical with the Fitzgerald-Lorentz contraction formula. Which observer is correct in his conclusions? The answer is that both are. It is not necessary to assume any real contraction in an absolute sense in either case. Because the velocity of light is the same for all observers, the time and space intervals which have certain values for an observer in one system will not appear to be the same to an observer in another system moving with respect to the first. The differences are very small unless the relative velocity is very great, and we can not hope to observe them in ordinary cases. Cathode rays and the beta rays from radioactive substances, and electrons rotating in atomic orbits, move with speeds approaching that of light, and in these cases some of the consequences of the special theory of relativity have been verified. One of these consequences is that the mass of a body is not constant, but varies with the speed, so that mass is also relative.

Thus it appears that not only uniform motions, but lengths, intervals of time and masses are relative and will appear different to two observers moving relatively to each other. Moreover, it follows from the same considerations that it is impossible except in special cases to determine whether two events are simultaneous or not. Newton believed that "absolute, true and mathematical time flows in virtue of its own nature uniformly and without reference to any external object." We now realize that this, like his conception of absolute, immovable space, is a metaphysical conception, corresponding to no physical reality which we can ever hope to establish.

From such considerations, it appears that our last hope of any absolute knowledge of the physical world is destroyed. With no objects or only one object in the universe, space would be meaningless. With the appearance of two objects at a measurable distance apart space is created, but this distance is not the same for different observers. With no object, or one object subject to no internal changes, time would be meaningless, there would be no past, no future, only an eternal present. If changes take place in an object, or if another object moves with reference to it, time is created, but the rate of flow of that time

will appear to be different to an observer in another moving system. We speak of the uniform rotation of the earth, but if its period should change and the period of revolution of the earth in its orbit should change in the same proportion, we would never know the difference, except that our lives might appear to be lengthened or shortened. If the rate of our bodily processes also changed in the same proportion, our lives might be lengthened or shortened a thousand fold, and we would never know it.

That there is a real world outside of ourselves, no physicist doubts, but it is full of illusions and we can learn little about it with our unaided senses. When we supplement these senses with such aids as the telescope, the microscope, the spectroscope, the photographic plate and the instruments used for detecting electric and magnetic effects, we can learn much concerning things lying outside the range of our sense perceptions, such things as ultra-violet and infra-red radiations, X-rays and many electromagnetic phenomena. Most of our scientific knowledge, especially that concerned with atomic phenomena, is based not directly on sense perception, but on inferences so logical that we feel satisfied with their validity, but after all they are only inferences.

The aim of scientific inquiry is to obtain descriptions of the external world which will be the same for all observers, that is to say, what are called invariant relations. The special theory of relativity shows that we can not obtain invariant relations of physical phenomena in terms of space alone or of time alone. Minkowski first called attention to the fact that the two are inseparable. Physical phenomena are events which occur at given points of *space* which may be specified by rectangular coordinates measured from a definite point of reference, and at a definite instant of *time*. Minkowski showed how to construct the mathematical expression for a combined time-space interval between two events which would be an invariant for all axes of reference moving with uniform velocity with respect to each other. In a two dimensional plane space, the square of the hypothenuse of a right-angled triangle is equal to the sum of the squares of the sides. If the hypothenuse is the distance between two points on a plane, it is invariant, but there are an infinite number of pairs of sides the sums of the squares of which will be equal to the square of this distance, all depending upon the orientation of the axes of reference. In three-dimensional space the square of the diagonal is equal to the sum of the squares of the sides of a right-angled solid, which again may have an infinite number of values. Time is not space, but it is one of the elements which fixes an event. Minkowski represents the joint space-time interval between two events by the length of what he calls a world line, which, by analogy with the length of the diagonal of a right-angled solid, is so defined that its space is equal to the sum of the squares of the three rectangular space coordinates of the event and the square of the time interval multiplied by a coefficient which we need not consider here. The length of a given world line is invariant, but associated with it are an infinite number of possible space and time coordinates, which may be regarded as the projections of the world line on variously oriented axes. Thus various values of the space intervals and time intervals measured along these axes may be associated with the length of a given world line between two events. This four-dimensional continuum fits the case of special relativity. For example, two events, such as flashes of lightning, may take place at different points at different times. To two observers in relative motion with respect to each other, the distance and the interval of time between these two events will appear different, but the expression for the combined space-time interval, the length of the world line, will be the same for all observers. By the application of this principle, all the laws of physics can be expressed in invariant form for all systems of reference having uniform rectilinear motion with respect to each other.

We need not vex ourselves with the futile attempt to visualize this apparently four-dimensional world. It is not four-dimensional in a purely spatial sense. It happens that the three dimensions of space are evident to our senses. We also think we have a definite notion of the duration of time, but it is not a notion which we can visualize, so that we need not expect that the combination of the time dimension with space dimensions will be evident to our senses. In fact, even the third dimension of ordinary space is to some extent an inference. A totally paralyzed person with one eye would perceive the external world only by means of a two-dimensional image thrown on his retina. He sees little more than he would in a photograph on a flat surface. With two eyes he would get an inkling of the third dimension through perspective, but only by moving his hands and legs and going from place to place could he perfect his notion of three dimensions. We must reconcile ourselves to the fact that our sense organs are too imperfect for us to perceive all that goes on in the world around us. It is futile to attempt to describe a symphony to one who has been deaf from birth or color to one who has always been blind. Yet it is possible to give to the deaf and the blind an idea of the sound waves and the light waves which may produce the sensations of sound and color in others more highly endowed. This analogy may reconcile us to our inability to visualize the four-dimensional world of Minkowski, and yet allow us to believe that the mathematical expression for the lengths of his world lines correspond to physical realities.

To prepare our minds for the reception of Einstein's later theory of general relativity we must submit to a still greater strain upon our credulity. We must not only accept the idea of four-dimensional time-space in a mathematical sense, but we must consider the consequences of a possible curvature of this space. On a plane surface the square of the diagonal of a right-angled triangle is equal to the sum of the squares of the sides. Such a space is called Euclidean. We have a similar expression for the diagonal of a cube in three-dimensional space, which is likewise Euclidean. By analogy, we may call Minkowski's four-dimensional space Euclidean if the square of the world line is equal to the sum of the squares of the space and time coordinates. But consider a curved surface, such as that of a calm lake. It appears to us to be plane, but we should find that if the lengths of the sides of a right-angled triangle are measured on this surface, the sum of the squares of the sides will not be equal to the square of the hypothenuse. The mathematician can prove that this indicates a curvature of the surface, and he can determine from the measurements how great the curvature is. Such a surface is not Euclidean. In Minkowski's four-dimensional time-space world, the sum of the squares of the space and time components of an event is ordinarily equal to the square of the length of the world line. In cases where this is not so, but one or more of the squared terms are multiplied by a factor different from unity, we may say that this space is curved. The shortest line between two points in a plane surface is a straight line. The shortest line between two points on a spherical surface is a curved line, part of a great circle, and is called a geodesic line. By analogy, we may consider that in Minkowski's four-dimensional world a world line is curved when the space is curved, and we may call it a geodesic line. We may represent the space-time interval between two successive ticks of a moving clock by the expression for the length of a world line. In curved space the successive world lines representing intervals between ticks would when joined, end to end, not lie on a straight line.

It is the later general theory of Einstein which is of most interest to us here, because its tests are entirely astronomical. The special theory of relativity applies only to uniform motion. In the case of accelerated motion there seems to be an absolute element. Acceleration is the rate of change of velocity. We can not detect our uniform motion through space, for example on a ship moving in calm water, but if the ship is suddenly stopped we become very much aware of the change in velocity. If we apply a mechanical force, such as a direct push or pull, to an object, its motion is accelerated. Conversely, if we observe that a body is accelerated, we infer the action of a force. An unsupported body falls to the earth with accelerated motion. We attribute this to a hypothetical force called gravity. The earth is subject to a uniform centripetal acceleration toward the sun, which we attribute to the same force. Gravitation has always been one of the great mysteries of the physical world. If a stone is whirled around at the end of a string, it is easy to visualize the force as due to the direct pull of the string. In what way does the sun exert its pull upon the earth? Action at a distance is repugnant to our minds, and it does not help us to imagine the ether as the medium through which this force is exerted, for earth and sun alike seem to slip freely through this ether. We might as well try to imagine the ocean pulling two ships together. We do not know nor can we ever expect to know the mechanism of gravitation. The Newtonian law merely describes the effect of this hypothetical force. If it turns out that the Newtonian law is an inadequate statement of observed facts, we shall need to correct it, and this is what Einstein has done in his general theory. We are satisfied to accept the Newtonian law because we have grown familiar with it, although we do not understand its physical basis in the least. We hesitate to accept the Einstein law, which is neither more nor less mysterious than that of Newton, because we have not become accustomed to it, yet in all probability the next generation will accept it without question and think that it understands it.

The basis of the general theory of relativity is the principle of equivalence. If we imagine a closed box in space at a great distance from attracting masses there will be no gravitative forces to consider. A man standing on the floor of the box will exert no pressure on the floor, in other words will be devoid of weight. If the box is suddenly accelerated upward, there will be a pressure created similar to that of which we become aware when in an elevator which suddenly starts upward. An apparent gravitational field is created which can not be distinguished from a true gravitational field. The two are equivalent. In general, therefore, we may say that when one reference system is accelerated with respect to another—say a ship with respect to the earth—forces are created which are equivalent to those produced in a gravitational field. For example, if the motion of the ship is suddenly checked, passengers are thrown forward as though a gravitational force pulling them toward the front of the ship had been created. A beam of light from an outside source passing through the accelerated box at right angles to its direction of motion would apparently be bent toward the floor. The principle of equivalence leads us to the conclusion, therefore, that a beam of light would be deflected in a gravitational field. A projectile moving uniformly in the same direction would appear to fall

in a parabolic path to the floor, as a projectile falls to the earth. If the light waves behaved in exactly the same manner, without loss of speed, we should get the so-called Newtonian deflection of .84 seconds of arc for a beam of light passing near the sun. But the curvature causes a change of the direction of the wave front, corresponding to a progressive decrease in velocity in approaching the sun. From this we may conclude that in a gravitational field there is a departure from the law of constancy of velocity of light assumed in the special theory of relativity, and that the change of direction of the wave front, corresponding to the case of ordinary refraction, will cause a further bending of the beam toward the sun. This causes the Newtonian deflection to be doubled, so that the predicted displacement is 1.75 seconds of arc, a prediction brilliantly confirmed by Director Campbell.

Futile as it may seem to try to understand first principles, we can not avoid speculating as to the explanation of the relative acceleration between the earth and the sun which we attribute to the force of gravitation. Newton's first law of motion, the law of inertia, asserts that a body on which no force acts, moves uniformly in a straight line. We can imagine conditions, however, in which this is not possible. Consider a two-dimensional surface such as that of a sphere to which a body is restricted, although it is free to move in any direction in this surface. In such a case if the body is set in motion, it will continue to move with uniform speed along the closest approximation it can make to a straight line, that is along a geodesic line. If we observe the motion of the body from a point outside the system and are unaware of the constraint to which it is subjected we will conclude that it is subject to an attractive force directed toward the center of the spherical surface. As a matter of fact there is no such force in this case, but the motion is determined solely by the curvature of the space in which the body moves.

When in the four-dimensional world of Minkowski the square of the length of a world line is equal to the sum of the squares of the one time coordinate and three space coordinates, we say that this space is Euclidean, that is, without curvature. It is at least formally analogous to the three-dimensional case in which the square of the diagonal of a cube is equal to the sum of the squares of the sides. In his general theory of relativity, Einstein assumes that in a gravitational field, space is not Euclidean, but curved. In such a case, as we found in the analogous case of a two-dimensional spherical surface, the coefficients of the squared terms, the sum of which is equal to the square of the world line, are not equal to unity. In such a curved space the natural path of a moving body is not a straight line, but a geodesic line. Thus the effects which we have attributed to gravitation are not dynamical, but are a direct consequence of the geometry of space. The earth moves around the sun not because it is attracted by a force, but because the law of inertia constrains it to move along the geodesic lines in the curved space surrounding the sun. By properly choosing the coefficients of his squared terms, Einstein has been able to obtain a law of gravitation which is identical with that of Newton at a distance from matter, but introduces a small correction term in the immediate neighborhood of large masses.

It is as fruitless to speculate upon the physical meaning of this apparent curvature of the space in the neighborhood of massive bodies as it is to speculate concerning any other theory of gravitation. All that we can expect of any hypothesis regarding fundamental things is that it shall lead to a mathematical law which shall as simply and exactly as possible describe observed facts, and additional weight must be attached to such hypotheses when they suggest the prediction of previously unsuspected facts and these predictions are verified by observation. These conditions are fulfilled by Einstein's theory. It exactly accounts for the anomalous rotation of the major axis of the orbit of Mercury, which is greater than that demanded by the Newtonian theory. It predicts a deflection of light waves passing by the sun which is double that demanded by the Newtonian theory, and this prediction has been verified. Another consequence of Einstein's theory is that any kind of a clock runs more slowly in a strong gravitational field. An atom emitting light vibrations is a clock, hence we may infer that the atoms in the solar atmosphere emit light waves of smaller frequency and greater wave length than the same atoms on the earth. This prediction has not yet been verified, as the predicted change of wave length is small and the disturbing factors in the solar atmosphere great, but it will not be surprising if this final verification of Einstein's epoch-making theory is found.

To sum up, we have seen that astronomy has rendered man great practical service; it has enlarged his knowledge of his environment near and far; it has given him some notion of the relation of himself and his earthly home to the universe; it has given him glimpses into the remote past and ground for speculations as to the distant future; it is unfolding the story of the evolution of worlds, and now it is unraveling some of the mysteries of time and space which have so long baffled the human mind. In addition, by adding to our general knowledge and developing the powers of the imagination, it has, in common with other sciences, directly and indirectly enlarged the ethical and esthetic values of life. Conduct is also relative; what is a virtue to-day may be a sin to-morrow. Good intentions alone can not carry

us far on the road of righteousness. To avoid blind groping, we must have that understanding of the relations of our conduct to our happiness and that of our fellow men which only the most complete knowledge of our earthly environment can give. Moreover, appreciation of the esthetic values which add so much to the joy of living seems dependent upon knowledge and the training of the imagination which it gives, for ignorant savages seem blind to the beauties of nature and unresponsive to the appeal of art.

Generous as the contributions of astronomy to civilization have been, there is promise of more to come. The universe is either finite or infinite, but our imaginations can grasp neither alternative in terms of the old ideas of space and time. On the basis of the general theory of relativity, it seems possible that astronomical observations may reveal to us a universe which is finite and yet unbounded, a self-contained universe keeping intact its store of matter and of radiant energy, with no infinite ocean of empty space around it, for there can be no space where there is no matter. This is the hope that is held out to us by Einstein and his co-workers, and to the astronomers we must leave the task of confirming that hope.

E. P. Lewis

University of California

ROBERT WIEDERSHEIM

By the death of Robert Wiedersheim, long the professor of anatomy in the University of Freiburg i/Br., another milepost has passed in the history of the comparative anatomy of vertebrates. Five days past his golden wedding anniversary, already afflicted by an inflammation of the lungs which was not supposed at the time to be serious, he fell asleep. In his hand he held the book with which he was beguiling himself when he died, "Die Geschichte der Anatomie."

Dr. Wiedersheim was born at Nürtingen am Neckar in the Würtemburg Black Forest, April 21, 1848, the son of a physician there. Fourteen days after his birth his mother died, and young Wiedersheim was brought up in the household of his grandfather, Immanuel Friedrich Otto, owner and proprietor of a cotton mill at Nürtingen. After attending the gymnasium at Stuttgart, with a short time in Lausanne, he studied further at the universities of Tübingen and Würzburg, obtaining his M.D. at the latter place, January 27, 1872. Here also he accepted an assistant professorship under Kölliker (1872–76), refusing a call to the University of Tokio as professor of anatomy there.

In the winter semester, 1876–77, Wiedersheim came to Freiburg as the assistant of Professor Alexander Ecker, whom he succeeded there as professor of anatomy at the latter's death in 1887. Here he remained until his retirement in 1918, leaving in his position Dr. Eugen Fischer, who is there at present.

While still an undergraduate he met his wife, Tilla Gruber, daughter of a Genoese banker, a German residing with his family in Italy, and married her July 7, 1873. In 1878, he built his summer home on the shores of Lake Constance, his beloved Villa Helios at Schachen near Lindau, which served him during many vacations. Here he retired after he left Freiburg, and here he died.

Wiedersheim, although he could never be induced to cross the ocean, travelled in Europe extensively, and made one short journey to Algeria. He visited England several times, especially to attend the Darwin Centenary in 1909; he travelled extensively also in France and Italy, including Sicily.

Aside from his work in human anatomy, which made him famous all over Germany, and brought students from other universities to Freiburg to take their anatomy with Wiedersheim, he gave a course in comparative anatomy, and received private students from other countries.

In 1882 appeared his "Lehrbuch der vergleichenden Anatomie," which he soon followed by a "Grundriss," explaining the same things in a more concise manner. This latter book he much preferred, and brought out several editions, the last (7th) appearing in 1909. It was his custom to keep a manuscript of this on his desk, making constant additions and revisions for use in newer editions. It soon became one of the largest and best of the text-books of comparative anatomy. In special monographs his work, though not extensive, was yet so carefully done that each was a classic. We need only mention "Das Kopfskelet der Urodelen," his work on the ear of the Ascalaboten, and the anatomy of Salamandrina perspicillata and Geotriton fuscus.

It is a well-recognized truism that, in the World War, the intellectuals suffered most. On April 14, 1917, three hostile bombs dropped from a British airship caused Wiedersheim's laboratory to burst into flames. It was totally destroyed. The minds of men were at the time aflame; there were ugly rumors of a similar treatment of British hospitals, there was a feeling of the need of reprisals. We are sure only that in this conflagration the great anatomical collection started by Alexander Ecker, his world-famous skull collection, some 200 microscopes and numberless anatomical charts, among others some from Professor Wiedersheim's skilled fingers, were almost wholly lost. Yet in relating these incidents Wiedersheim uttered no word of blame or censure, one of the last illustrations of the kindness of his disposition. Surely, in the death of Robert Wiedersheim the world lost far more than a great anatomist; to many he was a devoted friend. With

this tribute it is the wish of the writer to place a wreath upon his bier.

H. H. W.

HERMANN M. BIGGS[1]

Dr. Biggs was born at Trumansburg, N. Y., in 1859. He was of English descent. His early education was completed at the Trumansburg and Ithaca Academies and at the Cornell University Preparatory School. Entering Cornell University in 1879 he graduated A.B. in 1882 and received the degree of M.D. from Bellevue Hospital Medical College in 1883, thus accomplishing seven years work in three and one half. After an interneship in Bellevue Hospital in 1883–84, he studied the following year at Berlin and Greifswald in Germany. On his return to New York he became director of the newly opened Carnegie Laboratory of the Bellevue Hospital Medical College. Then for a time he held in succession at the latter institution the positions of lecturer on pathology, demonstrator of anatomy, professor of materia medica and therapeutics, professor of therapeutics and clinical medicine, adjunct professor of medicine and in 1912 professor of the practice of medicine.

In 1892 he organized the division of pathology and bacteriology in the Health Department of the City of New York, becoming pathologist and director of the laboratories. This position he held during a period of great activity in the department because he was constantly utilizing for practical ends the new revelations of science in bacteriology and preventive medicine and in conducting a campaign of education, not only of the people at large, but in the medical profession of New York City, many of whose eminent members steadily opposed the new methods and scoffed at the new light.

In 1902, under the mayoralty of Seth Low, a new office was created in the Health Department, that of general medical officer, and Dr. Biggs was made its first incumbent.

In 1913, after twenty-two years of active service, Dr. Biggs resigned from the Department of Health of the City of New York and was soon to enter upon a not less distinguished period of service to the state. Among the outstanding features of his service to the City of New York one may recall his early acceptance of the diphtheria antitoxin as of great and immediate importance, and his eager interest in its preparation in the new laboratories of the Department of Health, the first municipal bacteriological laboratories in the world to be established. These laboratories became at once a most important factor in the control and prevention of infectious diseases in the city and a model in administration and method of the application of science on a large scale to the welfare of mankind. His rare command of the qualities of knowledge, sincerity and tact enabled Dr. Biggs, through all the vicissitudes and turmoils of the political arena in New York, through all his two and twenty years of service, to carry out, unhindered, his plans as one by one they took form, to fulfill for his fellow men the promise of science in the prevention and assuagement of disease.

Dr. Biggs' greatest achievement and his most heartbreaking task was the launching of the campaign for the prevention and cure of tuberculosis. Early diagnosis was important and notification essential to success in general control and prevention. Eager, as was his wont, to secure the counsel of his fellows, he called together a score of the most eminent physicians of the City of New York at the Academy of Medicine to discuss the feasibility of notification of tuberculosis. The eminent physicians were almost unanimous in their opposition to the taking of any official steps in the matter. They feared panic, they predicted mental disturbance of the afflicted and their friends, they forecast the ruin of boarding houses, they distrusted the effectiveness of any of the proposed measures for prevention; and who knew, anyhow, whether the tubercle bacillus was more than a fiction or a blunder of the laboratories?

So it was clear that any direct movement forward would meet with the opposition of this group at least of eminent practitioners. Dr. Biggs was disappointed, of course, but not dismayed. His quiet remark when the session was over was, "Well, we must educate them and the public." And the laboratories were one of the most effective educational influences. It was in those days quite a task to make a microscopic examination of sputum for tubercle bacilli. Dr. Biggs proposed that his laboratories should make, free of charge, examinations for everybody who might present a specimen. And they did it. And presently all the world which was awake was making free examinations of sputum. Thus, through early diagnosis, a new hope was created for the stricken. This was actually the initiation of the anti-tuberculosis movement whose achievement and promise are so gratifying, to-day.

Then visiting nurses were secured for tuberculous patients sorely needing their ministrations; there followed compulsory segregation of the careless; the creation of the Otisville Sanitarium, fit example of a beneficent municipal tuberculosis hospital; and the Riverside for the hopelessly afflicted. So after some

[1] Memorial presented by the Executive Committee relating to the death on June 28, 1923, of Dr. Hermann M. Biggs, a member of the Board of Scientific Directors of the Rockefeller Institute since its organization more than twenty years ago.

years of constructive pioneer educational work, notification of tuberculosis came without a murmur even from those who survived among the eminent score of doctors who would have none of it. In 1886, the year before the attempt to enlist the interest of the medical profession in the new crusade, the mortality from tuberculosis in the City of New York was 3.55 per thousand of population. In 1910 it was 1.85; in 1920 it was 1.09; in 1922 it was 0.85.

Dr. Biggs seemed always to be devising some new means for the improvement of the public health. He was a man of constructive vision. Working through others, his accomplishments were prodigious. The bureau of child hygiene in the New York City Health Department was organized and grew into its great accomplishments under his inspiration.

He was a member of the Quarantine Commission which in 1892, under the auspices of the New York Chamber of Commerce, was concerned in rescuing from the hands of an incompetent commissioner a fleet of passenger ships bearing Asiatic cholera which were steadily massing in the lower bay without intelligent attempt to cleanse and discharge them. He was interested in the state quarantine so early as the period when it was the unquestioned practice of the then official health officer of the Port of New York to carry out—for a fee—the disinfection of ships from suspicious ports by burning a lump of sulphur in an iron pot set on the open deck forward, no matter which way the wind blew. For many years he was a member of the consulting board of Alvah H. Doty, the accomplished quarantine officer of a later day.

In 1917 he was head of a commission sent by the Rockefeller Foundation to study tuberculosis in France. He was also a member of the war relief commission of the Rockefeller Foundation and a member of the Council of National Defense. He was a member of the International Health Board of the Rockefeller Foundation. In 1920 he was for a time medical director general of the League of Red Cross Societies at Geneva. His services were always at the disposal of organizations for the advancement of the general welfare. He was attending or consulting physician to various hospitals in New York. He was a member of many learned societies. He was the recipient of academic and other honors. He was honorary fellow of the Royal College of Physicians of Edinburgh and of the Royal Sanitary Institute of Great Britain. In 1908, for distinguished work on public health, the order of Knight of Isabella the Catholic was conferred upon him by the King of Spain. He translated Hueppe's "Methods of bacterial investigations," one of the early books to get into English telling of the new world which was unfolding itself down on the border land of life, and was to prove of such vital significance to the well-being of mankind. He published papers on many subjects relating to the public health. And withal, he was a busy and successful practitioner of medicine.

In 1913, in the midst of the preoccupations of such a busy life as has been here portrayed, Dr. Biggs was appointed by the governor chairman of a commission to revise the public health law of the State of New York. Bringing to this task his great experience, his sound judgment, his remarkable constructive vision, his commission framed a law which may safely be called a model and whose principles and details have been widely followed throughout the United States. One of the notable features of this law over which Dr. Biggs had pondered long was the establishment of a Public Health Council of seven members to advise with the commissioner of health on all matters concerning which he might seek counsel or on which as students of the practical workings of the department they might choose to tender advice. The council is invested by the law with large powers of sanitary control through its authority to establish a sanitary code and from time to time to revise and mould it to meet the requirements of science, new methods in sanitation and the changing economic conditions of the time. In 1914, Dr. Biggs was appointed by the governor state commissioner of health and chairman of the Public Health Council.

Under the leadership of Dr. Biggs, order soon established itself in the department and a new spirit of loyalty to the service and its chief awakened. Health supervisorships of districts were created as paid offices, persistent effort was made to give to the position of local health officer throughout the state a dignity and recognition which had long been wanting and to secure more capable incumbents. The laboratories soon lost their forlorn incompetencies and under the guidance of Dr. Wadsworth, became adequate representatives of science and of the spirit of the new day in preventive mediicne.

One of the early accomplishments among his activities as commisisoner of health of the State of New York was the reorganization of the work for children, and very soon an efficient division of infant and maternity welfare was spreading its beneficent influences even to the remotest corners of the state. In 1913 the State of New York (exclusive of New York City) had an infant death rate of 120 per each thousand living births. In 1922 the infant death rate was 81.

It became a high privilege to serve on the Public Health Council if for no other reason than to see with what quiet, unobtrusive efficiency the commissioner carried the supervision of all the various lines of intense activity throughout the state. He was patient, except with sheer incompetency or neglect. His plans were well considered and far seeing; he was wise in

reading public opinion. And he could always wait. If his carefully matured project for some new public health activity which science and the time seemed to have made feasible went shipwrecked on legislative stupidity or on political ambitions or on professional jealousies, he never railed but serenely sought some other way or patiently bided his time awaiting, or more commonly, assisting, the slow growth of mass enlightenment.

Under his leadership the policies and organization of the Health Department of the State of New York have steadily developed until at the time of his death it was one of the most effective ministers to the public health in the United States and one of the foremost in the world.

It was obvious when the Board of Scientific Directors of the Rockefeller Institute was being formed that his intimate knowledge of the domain of public health, practical medicine and the new outlooks in research which were so inspiring at that time should lead to the selection of Dr. Biggs as one of the men to initiate the new venture. His interest in the progress and successes of the Institute has been keen. He has been most helpful in the deliberations of the board as well as in the adjustments of the relationship of the Institute to outside phases of practical medicine and research.

He was wise in counsel, he was ready in service, he was a good comrade; we shall miss him on this board.

SCIENTIFIC EVENTS

EXPERIMENT STATIONS IN FINLAND[1]

AGRICULTURAL experimentation in Finland is now being reorganized under a law passed this year, putting this work on a permanent basis. Research is now being conducted mainly by eight institutions. Of these the Central Agricultural Experiment Station situated at Dickursby, Anas, about 10 miles from Helsingfors, is operated by the government. It is organized into departments of plant cultivation, agricultural chemistry and physics, biology of domestic animals, plant bacteriology and diseases, and agricultural entomology. Each department is under the direction of a professor of the University of Helsingfors, and the staff also includes an assistant and a clerk with university training. Besides comparative vegetable tests, plant breeding is carried on, special attention being given to the breeding of oats. Many students of the agricultural department of the university are given training each year.

The Government Bureau for the Examination of Butter and other Edible Fats is situated at Hango. Its principal work consists in the examining of butter to be exported from the country, but it also conducts investigations of other food fats. It has a staff of dairy experts and chemists.

The Economic Investigational Bureau of the Agricultural Administration at Helsingfors conducts inquiries based on data procured from several hundred privately owned farms. The chief object is to furnish information in regard to the costs of agricultural production and the profitableness of various sized farms in different parts of the country.

The agro-geological section of the Geological Commission, also at Helsingfors, conducts investigations in regard to soils and prepares agro-geological maps for the different sections. This institution is maintained with state funds.

The Swamp Cultivating Experimental Station of Lettensue, about 75 miles north of Helsingfors, is owned by the Suomen Suoviljelysyhdistys (Finland Swamp Reclamation Society), which receives financial aid from the state. The station conducts experiments in the cultivating, ditching and fertilizing of swamps. Similar stations are located at Ilmajoki, about 270 miles north of Helsingfors, where special attention is given to pasture studies on peat bogs, and at Tohmajarvi, about 417 miles east of Helsingfors.

The Plant Breeding Station of Tammisto at Malm, about seven miles from Helsingfors, is owned by the Keskusosuusliika Hankkija (Hankkija Cooperative Society). Its work consists in the breeding of the more important plants, and it is under the direction of a trained specialist.

In addition to the foregoing, the cattle breeding societies operating in Finland and receiving state aid conduct, in connection with the keeping of records of purebred stock, investigations in regard to the heredity of domestic animals. Of these societies the most important are the Society for the Breeding of Ayrshires at Helsingfors, the West Finnish Society for the Breeding of Domestic Animals at Karkku (near Tammerfors), and the East Finnish Society for the Breeding of Domestic Animals at Kuopio.

[1] From the *Experiment Station Record.*

ROTHAMSTED EXPERIMENTAL STATION

ACCORDING to the London *Times*, the report of the Rothamsted Experimental Station, Harpenden, for 1921–22, which has recently been issued, contains information which will be of value to the agricultural community. Perhaps the most significant remark in the whole report is contained in a comment on the expenditure and cash returns per acre of the ground cultivated by the station. Profits are shown in the period from October, 1919, to September, 1920, but thereafter practically every item is a deficit, and it is observed that "from 1920 onwards the financial results are deplorable and show clearly why many of the arable farmers of to-day are in their present position."

The station, which has been in receipt of government grants since 1911, has been organized so as to bring it into touch with modern conditions of agriculture, on the one side, and with scientific advance, on the other. Its activities range from oil cultivation to fertilizer investigations, the effect of manures on crops, and plant diseases. As the fundamental basis of agriculture is the production of crops, the work at Rothamsted is mainly concerned with this, and the natural subdivisions of the investigation are soil cultivation, the feeding of crops, and the maintenance of healthy conditions of plant growth. Cultivation has been reduced almost to a fine art, but as costs are the dominating factor in practical farming experiments are continually carried out with the object of discovering means of reducing expense. For instance, the power needed for ploughing can be reduced by suitable treatment of the land. Chalking heavy soil may effect a saving of as much as 15 per cent. in the power used, while farmyard manure, coarse ashes and even artificial manure can all effect similar economies.

As more than thirty artificial manures are now available to the farmer, and as their effect varies on different farms and with the weather, there is an obvious need for some general rules by which farmers may be guided. The report, having stated that a risk must always attach to crop yields, adds that it is hoped that they may eventually become calculable and therefore insurable. The difficulties of the work are great, but they are being steadily overcome, though at present the effect of differences in soil type and climatic conditions are not known with certitude for various parts of the country.

The complete report may be obtained from the Secretary of the Rothamsted Experimental Station, Harpenden.

SYMPOSIUM ON HEAT TRANSFER

A symposium on heat transfer will be held at the spring meeting of the American Chemical Society, under the auspices of the Division of Industrial and Engineering Chemistry.

While the final program is not available, a number of papers are in preparation by writers well versed in various applications of heat transference. These papers may be classified as follows:

Heat Losses by Radiation plus Convection, through Bare and Insulated Surfaces.
- a. From Pipes.
- b. From Furnace Walls.
- c. From Miscellaneous Shapes.

Heating or Cooling of Non-Condensable Cases.
- a. The Warming of Air in Hot-blast Heaters.

Heating or Cooling of Liquids Flowing Inside Pipes.
- a. Water.
- b. Oils.

Condensation.
- a. In Surface Condensers and Water-heaters.

Evaporation.
- a. The Analysis of Certain Comparative Tests on Evaporators.
- b. Heat Transfer in Enameled Apparatus.

Miscellaneous Topics.
- a. "A Heat Meter."
- b. The Determination of Air in Steam, and the Importance of this Factor in Heat Transmission.

In order that those interested may have ample time prior to the meeting to prepare discussion of these papers, it has been decided to issue advance copies, or preprints, bound under one cover. To this end it is necessary that the complete manuscript be in the hands of the chairman not later than January 15, 1924.

Professor W. H. McAdams, of the Massachusetts Institute of Technology, is chairman of this symposium. It is of such an important nature that two half days will be devoted to the presentation and discussion of papers.

Should preprints be issued, a copy will be sent to each paid member of the division.

Erle M. Billings,
Secretary

THE SEISMOLOGICAL SOCIETY OF AMERICA

At a meeting of the board of directors of the Seismological Society of America held in San Francisco on October 19 the following officers were elected for the year 1923–24: Bailey Willis, of Stanford University, *president;* W. W. Campbell, University of California, *first vice-president;* R. W. Sayles, Harvard University, *second vice-president;* H. O. Wood, Carnegie Institution, *third vice-president;* S. D. Townley, Stanford University, *secretary-treasurer.*

During the past year the Seismological Society published a large Fault Map of California on the scale of eight miles to the inch. This has been distributed to the members of the society and subscribers to the quarterly *Bulletin* published by the society, and the remaining copies are now on sale. The sale of the maps is in charge of the secretary of the society, Stanford University, California. When mounted the map is 6 x 7 feet in size. The base of the map was prepared by the U. S. Geological Survey and all known active and dead faults have been drawn on it from the best information available. The map also contains the offshore contour lines from San Diego to San Francisco. These were determined by the Hydrographic Office of the U. S. Navy Department, in the fall of 1922, by the use of the Sonic method. The data of the fault lines were compiled by Bailey Willis and H. O. Wood and the publication of the map has

been made possible through the cooperation of various institutions and individuals, including the U. S. Hydrograph Office, the U. S. Navy Department, the U. S. Geological Survey, the Carnegie Institution of Washington, the University of California, Stanford University and the advisory committee on seismology of the Carnegie Institution.

During the present year the officers of the society and the editors of the *Bulletin* expect to direct their efforts toward an educational campaign for the erection of earthquake-proof buildings.

STUDY OF ENGINEERING EDUCATION

THE Society for the Promotion of Engineering Education recently received from the Carnegie Corporation a communication stating that the corporation has set aside the sum of $108,000 "for the purpose of making possible a study of engineering education" under the direction of the society. The letter of President F. P. Keppel, of the Carnegie Corporation, addressed to Professor C. F. Scott, chairman of the society's board of investigation and coordination, announces that $24,000 is made available "during the present fiscal year and $12,000 during the fiscal year 1924, with the understanding that if, in the judgment of the executive committee, substantial progress shall have been made in this study by January 1, 1925, the balance of the $108,000 will be made available to the society as follows: $24,000 additional during the fiscal year 1924 and $48,000 during the fiscal year 1925."

William E. Wickenden, assistant vice-president of the American Telephone and Telegraph Company, has been appointed director of the investigation.

The Society for the Promotion of Engineering Education, which has more than 1,500 individual members and 86 institutional members, voted at its annual meeting in June, 1922, to expand its service to technical schools by a study of the training of engineers. A committee was appointed "to formulate an answer to the question, What can the society do in a comprehensive way to develop, broaden and enrich engineering education?" The report of this committee led to the organization in September, 1922, of a board of investigation and coordination, composed of Charles F. Scott, then president of the society; J. H. Dunlap, M. E. Cooley, F. W. McNair and D. C. Jackson. President Scott addressed a letter in October, 1922, to deans and presidents of engineering schools throughout the United States, "asking counsel and suggestions from the engineering schools for the guidance of the board." Abstracts from replies to this letter were printed in the November, 1922, issue of *Engineering Education*, the bulletin of the society. At the 1923 annual meeting last June, the society pledged "the support of its individual members to the proposed program of investigation of engineering education."

THE ROLLIN D. SALISBURY MEMORIAL

THE University of Chicago announces that a committee, consisting of Thomas E. Donnelley, chairman, from the board of trustees; Professor H. H. Barrows, chairman of the department of geography; Professor E. S. Bastin, chairman of the department of geology, and two other persons not members of the Board of Trustees or of the University faculties, has been appointed to raise a fund of $100,000 to $150,000 to be known as the Rollin D. Salisbury Memorial Fund for the promotion of research in the fields of geology and geography.

The income from the fund is to be used for the following specific classes of projects: (*a*) Field research expeditions; (*b*) office and laboratory researches; (*c*) research fellowship grants to graduate students of special promise for the conduct of specific researches; (*d*) aid in the publication of research results when such publication can not be otherwise arranged, and (*e*) other projects that come appropriately under the caption of promotion of research.

Professor Salisbury, who for twenty years was dean of the Ogden Graduate School of Science, head of the department of geography for sixteen years, and head of the department of geology at the time of his death in 1922, left a bequest to the university of a large fund for the endowment of scientific fellowships. Dean Salisbury's influence was widely extended through graduates in geology and geography who have gone to important positions in many educational institutions.

SCIENTIFIC NOTES AND NEWS

THE Nobel prize in physics has been awarded to Dr. Robert Andrews Millikan, director of the Norman Bridge Laboratory of Physics and chairman of the Administrative Council of the California Institute of Technology. The only previous award of this prize in America was to Professor A. A. Michelson, of the University of Chicago, in 1907.

THE Josiah Willard Gibbs lectures, recently established by the American Mathematical Society, were to have been inaugurated this winter with an address on the Einstein Theory by the late Charles Proteus Steinmetz.

DR. STEPHEN MOULTON BABCOCK, known as the discoverer of the Babcock test for fat in milk and for research on milk, celebrated his eightieth birthday at his home in Madison, Wis., on October 22. In 1901 a medal was given to Dr. Babcock by the state of Wisconsin, bearing the inscription "In recognition of the great value to the people of this state and to the whole world of the invention and discoveries of Professor Stephen Moulton Babcock, of the University of Wisconsin, and his unselfish dedication of these in-

ventions to the public service, the state of Wisconsin presents to Professor Babcock this medal."

PROFESSOR VLADIMIR KARAPETOFF, of the School of Electrical Engineering, Cornell University, has been awarded a prize of four thousand francs by the Montefiore Foundation of the University of Liège, Belgium. The award was made for his kinematic computing devices of electrical machinery, described in the technical press during the last three years. A committee of five Belgian and five foreign members, which makes these awards, has characterized this work as an expression of a "new idea which may lead to important developments in the domain of electricity."

THE Cross of the Legion of Honor for war service has been awarded to Dr. John J. Moorhead, of New York City. This is his third decoration from the French Government. Dr. Moorehead, who is professor of surgery at the New York Post-Graduate School and Hospital, was a lieutenant colonel in the Medical Corps of the A. E. F. for nineteen months.

THE Lenard prizes for distinguished work in colloid chemistry were recently awarded by the German Kolloidgesellschaft to R. Zsigmondy, professor of inorganic chemistry at Göttingen, for his discovery of the ultramicroscope, and to Dr. W. Pauli, professor of internal medicine at Vienna, for research on proteins.

DRS. G. E. H. ROGER, dean of the Paris Faculty of Medicine, J. L. Faure, professor of surgery in the same faculty; L. J. Hugouenq, honorary dean of the Lyons Faculty of Medicine; Maurice de Fleury, member of the Academy of Medicine, and A. Lumière have been made commanders of the Legion of Honor.

PROFESSOR ALEXIS THOMSON, of Edinburgh, is about to retire from the chair of surgery in the University of Edinburgh, a post he has held since 1909.

PRESIDENT RALPH D. HETZEL, of the University of New Hampshire, was elected president of the New England Association of Land Grant Colleges and Universities at the annual meeting held at Kingston, R. I., on November 2 and 3. Dean Joseph L. Hills, of the University of Vermont, was made secretary-treasurer.

DR. DAVID D. SCANNELL, who has already served three terms of three years each as a member of the Boston school committee, has been nominated for another term by the Public School Association of that city. Dr. Scannel has been on the teaching staffs of the Harvard and the Tufts Medical Schools and is a visiting surgeon at the Boston City Hospital.

PROFESSOR WILLIAM A. WITHERS, head of the department of chemistry in North Carolina State College, was recently elected president of the Chamber of Commerce of Raleigh, N. C.

DR. MARCUS BENJAMIN, of the U. S. National Museum, represented Columbia University at the inauguration of William Mather Lewis as president of George Washington University on November 7.

W. A. MCRAE, commissioner of agriculture of Florida for twelve years, has resigned. The governor has appointed Nathan Mayo, of Summerfield, Marion County, to be his successor. Mr. McRae will be connected with a large development company in Florida.

THE Laboratory of Pharmacognosy with the Drug Control Laboratory of the Bureau of Chemistry have been consolidated. The laboratory thus formed will be designated as the Drug Control Laboratory and will be in charge of Dr. G. W. Hoover.

DR. HARRY P. SWIFT has been appointed a special deputy commissioner of health for New York City to serve without compensation.

DR. FODOR, assistant to Abderhalden, has been asked to go to Palestine to superintend the foundation and take charge of an institute for physiologic chemistry.

DR. C. A. BROWNE, chief of the Bureau of Chemistry, U. S. Department of Agriculture, left Washington on October 25 for a three weeks' trip to some of the branch laboratories of the Bureau of Chemistry.

PROFESSOR CHARLES F. SHAW, of the Department of Soil Technology, University of California, has returned from a six months' sabbatical leave spent in Honolulu, Australia and New Zealand. In Australia an extended trip was made by motor into the interior, to study soil and agricultural conditions as well as the degree of settlement and development. Many soil samples were brought back for further study.

THE sum of £100 has been granted by the managers of the Balfour Fund to Mr. Cyril Crossland, M.A., of Clare College, Cambridge, in aid of his researches into the biology of the coral reefs and banks of the South Pacific.

THE Norwegian Arctic explorer, Christian Leden, has returned from Greenland, bringing back ethnographic and zoological collections for the Peabody Museum, Harvard University.

DR. PAUL KAMMERER, of the Biological Research Institute of Vienna, will shortly visit the United States, where he will lecture.

THE annual meeting of the Sigma Xi Club of Southern California was held on Friday evening, October 19, at Occidental College, Los Angeles.

After an informal dinner, Dr. D. T. MacDougal, director of botanical research in the Carnegie Institution, delivered an illustrated lecture on "The physical basis of life." The following officers were elected for the ensuing year: *President*, Dr. Willett L. Hardin; *vice-president*, Dr. LeRoy S. Weatherby; *secretary*, Catherine V. Beers; *treasurer*, Dr. Elbert E. Chandler.

PROFESSOR HARLOW SHAPLEY, director of the Harvard College Observatory, will lecture at Brown University in the Marshall Woods Series on January 15 on "The Origin of the World."

DR. GEORGE D. BIRKHOFF, professor of mathematics at Harvard University, will give at the Lowell Institute, Boston, during the month of December, a series of six lectures on "The origin, nature and influence of relativity." The dates and titles of the individual lectures are:

Tuesday, Dec. 4—"Euclid, Newton, Faraday, Einstein."

Friday, Dec. 7—"The nature of space and time."

Tuesday, Dec. 11—"The old and new theories of gravitation."

Friday, Dec. 14—"The experimental tests of relativity."

Tuesday, Dec. 18—"Some relative paradoxes and their explanation."

Friday, Dec. 21—"The philosophical influence of relativity."

THE *Journal* of the American Medical Association writes: "Dr. Ludvig Hektoen, Chicago, is chairman of a large committee which has made an appeal to American physicians to come to the aid of practitioners, research workers and medical students of Germany who face a winter of great distress and privation. As alumni of America's universities and professional schools, the committee says, we can not afford to stand idly by while scientific and medical Germany disappears. We have shared in the benefit of antitoxins, of chemotherapy, of the Roentgen ray. We shall not want the future to record that we were indifferent when the science of a Ludwig, a Virchow, a Helmholtz, a Koch or a Fischer was in dire need. Now is the time of greatest need. The old men of the profession in Germany are in most instances absolute paupers, their life's accumulation not sufficing to buy a slice of bread. Every effort will be made to safeguard the transmission of contributions to this fund, which, if expedient, will be made through American government channels. Make your check payable to 'American Aid for German Medical Science,' and mail to Dr. Hektoen at 637 South Wood Street, Chicago."

UNIVERSITY AND EDUCATIONAL NOTES

DR. FRANKLIN CHAMBERS MCLEAN, the newly elected professor of medicine at the University of Chicago, will take part in the work of organizing the Medical School at the University. Dr. McLean has had the experience of organizing the Peking Union Medical College, upon whose buildings and equipment $9,000,000 have already been expended.

W. L. SLATE, JR., professor of agronomy in the Connecticut Agricultural College and vice director of the stations, has been appointed director to succeed Dr. E. H. Jenkins, who recently retired.

PROFESSOR C. W. PARMELEE has been made head of the department of Ceramic Engineering at the University of Illinois. He has been connected with the institution since 1916 as professor of ceramic engineering and during the past year has served as acting head.

DR. FRANK W. CHAMBERLAIN, who for five years has been acting dean of the division of veterinary science in the Michigan Agricultural College, has resigned in order to devote his full time to the department of anatomy.

THE chair of biology and pharmacognosy at the Philadelphia College of Pharmacy and Science, recently vacated by Professor Heber W. Youngken, who accepted an offer to occupy a similar chair at the Massachusetts College of Pharmacy, has been filled by the appointment of Dr. Arno Viehoever, who has had charge of the laboratory of pharmacognosy of the Bureau of Chemistry, U. S. Department of Agriculture, since 1914.

H. C. HOWARD has been appointed assistant professor of chemistry at the University of Missouri. Dr. Howard has been research chemist on the staff of the B. F. Goodrich Company.

J. S. BROWN, assistant geologist in the Geological Survey, has accepted a position for one year in the department of geology, Missouri School of Mines, Rolla, Missouri.

DR. GRUBER, formerly prosector at the municipal hospital in Mainz, has been called to Innsbruck as director of the Anatomical Institute, to succeed Professor Pommer.

PROFESSOR KUZYNSKI, a department head of the Berlin Pathological Institute, has accepted a call to the West Siberian University of Omsk, where he will serve as a pathologist, being entrusted more particularly with epidemiological research.

DISCUSSION AND CORRESPONDENCE

CLIMATIC CHANGES

DR. HUMPHREYS' review of "Climatic changes, their nature and causes," by Dr. Ellsworth Huntington and Dr. Stephen Sargent Visher (Yale University Press, 1922), in SCIENCE, Vol. LVII., pp. 389–391, March 30, 1923, conveys, I feel sure, an erroneous impression, for it fails to treat commendable features and to give any idea of the contents of the book.

"Climatic Changes" is a very comprehensive treatment of the wide subject of climatic changes in the history of the earth. The work begins with chapters on the remarkable uniformity of the climate in geologic time and on the variability of the climate. The following types of climatic sequences are distinguished: (1) Cosmic uniformity; (2) secular progression; (3) geologic oscillations; (4) glacial fluctuations; (5) orbital precessions; (6) historical pulsations; (7) Brückner periods; (8) sunspot cycles; (9) seasonal alternations; (10) pleionian migrations; (11) cyclonic vacillations; (12) daily vibrations.

A review and discussion of the principal hypotheses of the causes of climatic changes brings the treatment up to Huntington's own hypothesis, the solar cyclonic. This hypothesis is shortly as follows: Newcomb and Köppen have shown that the temperature of the earth's surface varies in harmony with variations in the number and area of the sunspots. Furthermore, Abbot has found that the amount of heat radiated from the sun also varies, and that in general the variations correspond with those of the sunspots. Sunspot maximum corresponds to the lowest temperature at the surface of the earth. Finally, it has been found that atmospheric pressure also varies in harmony with the number of sunspots. The variations are different in different parts of the earth, but systematic, and the net result is that, when sunspots are numerous, the earth's storminess increases. This interferes with the trade winds of low latitudes and the prevailing westerlies of higher latitudes, causing frequent hurricanes in the tropics and more frequent and severe cyclones in the temperate regions. With the change in storminess there naturally goes a change in rainfall. Thus, when the atmosphere of the sun is particularly disturbed, the meteorological differences between different parts of the earth's surface are strengthened.

The low temperature during times of many sunspots may be due largely to convection and to increased velocity of the winds by which the surface of the earth is actually cooled off a little. The cause of the storminess, when the sun's atmosphere is disturbed, is not quite clear, but, beside the heating of the earth's surface by the sun, electric phenomena of some kind appear to play a rôle.

Investigations have shown that sunspot cycles on a small scale present almost the same phenomena as do historic or glacial fluctuations. "When sunspots are numerous, storminess increases markedly in a belt near the northern border of the area of greatest storminess, that is, in southern Canada and thence across the Atlantic to the North Sea and Scandinavia. Corresponding with this is the fact that the evidence as to climatic pulsations in historic times indicates that regions along this path, for instance Greenland, the North Sea region, and southern Scandinavia, were visited by especially frequent and severe storms at the climax of each pulsation. Moreover, the greatest accumulations of ice in the glacial period were on the poleward border of the general regions where now the storms appear to increase most at times of solar activity."[1] "From these and many other lines of evidence it seems probable that historic pulsations and glacial fluctuations are nothing more than sunspot cycles on a large scale."[2]

After these introductory and theoretical chapters the authors take up the discussion of certain climatic problems. The headings of the chapters will give an idea of the diversity of the problems dealt with: "The climate of history;" "The climatic stress of the fourteenth century;" "Glaciation according to the solar cyclonic hypothesis;" Some problems of glacial periods;" "The origin of loess;" "Causes of mild geological climates;" "Terrestrial causes of climatic changes;" "Post-glacial crustal movements and climatic changes;" "The changing composition of oceans and atmosphere;" "The effect of other bodies on the sun;" "The sun's journey through space;" "The earth's crust and the sun."

In certain respects the undersigned disagrees with the conclusions of "Climatic Changes." Thus, when percipitation is considered to be of greater importance than temperature for the Pleistocene glaciations, it may have been overestimated. The best known glacialists, practically without exception, regard temperature as the chief controlling factor. Particularly do A. Penck, E. Brückner and A. von Reinhard regard temperature, not precipitation, as the decisive factor for the glaciations in the Alps and the Caucasus.

The nourishment of the ice sheets, according to Huntington and Visher, occurred largely by snowfall from cyclonic storms.[3] They infer that heavy precipitation and the formation of great snowfields took place first in the central areas of what later became the great continental ice sheets. Hence ice began to flow out from these centers. Later, however, the extreme development of high pressure areas over the ice

[1] P. 57, 60.

[2] P. 60.

[3] Pp. 116, 125, 136.

sheets is supposed to have forced the cyclonic storms to skirt the ice rather than cross its central parts. Our knowledge on this point is very limited, but since boulders were transported by the European ice sheets from near the center of glaciation out to the terminal moraines in central Europe, the expansion of the ice sheet to a large degree must have been controlled by precipitation in its central parts. Recently Simpson[4] has given a seemingly very good explanation of the snowfall in the Antarctic anticyclone. The precipitation, according to his view, is brought about by the low temperature of the lower strata of the air. This air is raised and cooled still further during blizzards and hence gives up the small amount of moisture which it contains.

The opinion that evaporation during the glaciation was greater than normally[5] perhaps is open to doubt, but that there was a considerable transport of moisture from low to high latitudes seems to be certain.[6]

The discussion of the causes of the disappearance of the ice sheets is not quite consistent.[7] It starts with correctly setting forth rise of temperature and diminution of precipitation as the chief general causes, but ends with largely attributing the vanishing of the different sheets of land ice to more local conditions. Most studies of the disappearance of the North European and the Labradorean ice sheets seem to show that during the ice retreat the temperature was relatively high and the precipitation slight.

Again, topographic conditions *can* readily explain many climatic problems, but their actual rôle seems sometimes to have been overestimated. So, the supposed good example of close relationship between high elevation of land and continental climate, and low elevation and maritime climate in northwest Europe during late-glacial and post-glacial time, maintained by C. E. P. Brooks, is partly unfounded, as it is based upon an incorrect interpretation of the changes of level. Even the moderate view taken in "Climatic Changes," pp. 215–222, goes too far. During the transition between the late-glacial and post-glacial periods, that is in Ancylus or boreal time, there was no extensive elevation, no continental phase as far as the land is concerned; and recently Lennart von Post seems to prove that the climate instead of being continental as supposed was maritime with dry summers and winters rich in precipitation.

In the discussion of the origin of glacial loess, which is supposed to have been accumulated mainly during the retreat of the ice, the undersigned misses references to B. Shimek, A. Jentzsch, and P. Tutkowski, who have expressed similar ideas.

A very strong side of "Climatic Changes" is that it really faces the difficulties, and takes up the problems which call for discussion, even if our present imperfect knowledge does not permit a satisfactory explanation of all of them. The solar cyclonic hypothesis seems more competent than any other existing hypothesis to explain the complexity and the rapid and heterogeneous changes of the Pleistocene climate, which are now beginning to be fairly well known, especially thorough studies in Sweden. Our present knowledge of the Pleistocene climate eliminates most and perhaps all the hypotheses which seek the causes of climatic variations in terrestrial conditions only. It seems as if Huntington has found a very important, perhaps the chief, cause of climatic changes.

ERNST ANTEVS

[4] G. C. Simpson, "Meteorology," Vol. I.—British Antarctic Expedition, 1910–1913. Calcutta, 1919. Reference on pp. 256–269.

[5] Pp. 113 ,114.

[6] P. 118.

[7] P. 128.

COLOR HEARING

I HAVE been interested for a long time in color hearing, and therefore read eagerly the article by Professor Horace B. English, of Antioch College, in SCIENCE of April 13, "And a little child shall lead them." The deductions of the three-year-old were charming.

I add my personal experience. Having met a friend in town some years ago, we fell into conversation on the possibilities of color hearing, which had been characterized as absurd. Going to my home, I said to my mother, without any preliminaries, "Mother, what color is my voice?" Without hesitation and as if I had asked her the color of a ribbon or a book-cover, she replied, "Dove-color."

I expressed my surprise that she should hear color. "Why," said she, "I have always heard color. When I went to school, there was a little girl whom I disliked very much, because she had such a yellow voice." But in all her long life (she was then over eighty) color hearing had never been spoken of. I then asked her the color of the voices of various friends, which she gave with perfect readiness. She characterized the voice of Louis Prang as having the colors of the rainbow.

Some days after this conversation, I went to New York on my way to Brooklyn to speak before an educational gathering on "Color." As I walked along Broadway, I noticed in a shop window, in which Oriental rugs were displayed, a placard which said, "A noted East Indian will tell fortunes, will read the hand and will tell the color of the voice." Feeling that I might get material appropriate to the address I was to give, I went in and was shown to a tent-like booth, in which was seated a fine-looking Hindu in full Oriental costume.

He received me in a dignified manner, read my

hand and told my fortune. I asked the color of my voice. He asked me to count to twenty and to say the alphabet. I did so. He looked thoughtful, pondered a moment, and said, "You will think it strange, perhaps—your voice is blue-violet—an intellectual voice."

It has seemed to me that the color hearing was, in the case of my mother and of the Hindu, virtually the same—dove-color and blue-violet—the elements of the colors being alike.

Mary Dana Hicks Prang

Boston, Mass.

A HISTORICAL NOTE ON SEX DETERMINATION IN PIGEONS

In connection with papers on sex determination in pigeons, setting forth the observations of C. O. Whitman and O. Riddle, it is interesting to find that an old French book records a part of the tradition of bird-fanciers regarding the tendency of some eggs to develop into males.

Riddle has summarized the extensive researches of Whitman and of himself as follows: "In the pigeons the first egg is smaller and is a male, the second is larger and usually a female, while as the season advances the smaller ones also are female-producers."[1]

In the reprint collection of the U. S. Fisheries Laboratory at Woods Hole, Mass., the writer recently came upon a small booklet by Jules Gautier entitled "La Fécondation artificielle," Troisème edition, Paris, 1881, which has on page 21 the following footnote:

> Chose remarquable! c'est que les oiseaux qui n'ont que deux oeufs par couvée (pigeons, colombes) en produisent un pour chaque sexe. Le premier pondu est toujours affecté au mâle, et celui-ci éclôt ordinairement avant la femelle.

The shrewd observations of breeders of horses, cattle and dogs are also deserving of consideration in planning investigations on the physiological basis of sex determination, and have already been shown to be worth nearly as much as certain clinical records.

F. E. Chidester

West Virginia University

ZOOLOGICAL NOMENCLATURE

Nomenclature: Notice to the zoological profession that suspension of the rules has been asked in the case of *Spirifer* Sow, 1816, and *Syringothyris* Winchell, 1863.

In accordance with prescribed routine, the secretary of the International Commission of Zoological Nomenclature has the honor herewith to notify the members of the zoological profession that Miss Helen M. Muir Wood, of the British Museum of Natural History, has submitted the generic names *Spirifer* Sow, 1816, and *Syringothyris* Winchell, 1863, to the International Commission, for suspension of rules, with a view to retaining *Anomia striata* Martin as genotype of *Spirifer* and *Syringothyris typa* (s. *Spirifer carteri* Hall) as genotype of *Syringothyris*.

The argument is presented: (1) that under the rules *Anomia cuspidata* Martin is type of *Spirifer* and *Syringothyris* is synonym of *Spirifer;* (2) but for 70 years practically all authors have, in conscious opposition to the rules, taken *A. striata* as type of *Spirifer* and *Spirifer carteri* s. *Sy. typa* as type of *Syringothyris;* (3) so many species are involved in this instance that the application of the rules would present greater confusion than uniformity.

The secretary will postpone vote on this case for one year and invites expression of opinion for or against suspension in the premises.

C. W. Stiles,
Secretary

Hygienic Laboratory,
Washington, D. C.

QUOTATIONS

RECOGNITION OF SCIENTIFIC WORK

L. H. Baekeland, just returned from an extensive trip with renewed appreciation for the opportunities and privileges of the United States, recently brought to our attention the desirability of having Congress recognize in some specific and definite way the triumphs of our men of science, particularly those in department circles. Then in the editorial section of the *New York World* for September 2, Ellwood Hendrick discussed the same sentiments and made a plea for such recognition by Congress. We wish to add our voice and urge that something be done in a proper way to have our law-makers realize that "the United States is the only civilized country in the world that does not recognize distinguished service by civilians. In the British Empire they make them lords or knights—and we can not do that. In France, Italy, Spain, Belgium, Portugal, China, Japan, and even in Soviet Russia, they give decorations. We do not give decorations to civilians. Moreover, the insignia of decorations have been preempted by so many private organizations in this country that a button in the lapel of a man's coat is without its significance elsewhere."

But there are other ways in which this Nation can express its thanks. Perhaps some day we may go as far as our neighbor Canada and grant a substantial annuity to a man who has made a scientific discovery of great importance to the public. There seems no

[1] Riddle, O., "The determination of sex and its experimental control," *Bull.* Am. Ac. Med., Vol. 15, No. 5, October, 1914.

why Congress could not pass an act, engrossed and signed by the President of the United States, consisting of a proper preamble and resolution commencing and expressing gratitude to a man who has devoted many years of his life, his ability as a scientist and perhaps as an inventor, to the welfare of the republic.

Such a document would be invaluable to the recipients. Moreover, the adoption of a policy of this kind might be the first step in working out a really adequate plan for rewarding scientists, many of whom have steadfastly refused more remunerative offers out of pure patriotism. Such action might be taken only upon the retirement of a departmental head or bureau chief, but those are details. The point we want to make now is that the devotion and sacrifice of our chemists to the science should be recognized in some way.—*Journal of Industrial and Engineering Chemistry.*

SCIENTIFIC BOOKS

The Psychic Life of Insects. By E. L. BOUVIER. Translated by L. O. HOWARD. New York. The Century Company, 1922.

THE behavior of the very lowest animals is determined largely by tropisms and reflexes, that is, inevitable physical responses to physico-chemical stimuli. The behavior of the very highest animals is chiefly determined by intelligence and reason. But the behavior of by far the largest number of animal kinds is mostly determined by instinct. Conspicuous and most abundant among these animals with the instinct kind of mind are the insects, constituting, as zoologists classify animals, only a single class in one of the several great animal phyla, but comprising perhaps three fourths of all the known species of animals. That means that there are approximately 400,000 different kinds of known insects. Guessing how many living kinds we do not yet know is a much pursued sport of entomologists.

Since the discovery of Fabre by the general public the psychic life of insects has been a favorite subject of reading, between new novels. Maeterlinck's "Life of the Bee" has helped to encourage this reading, while numerous other books about insect life written by men and women who know much about this life, but usually a little less about writing, are readily available to readers intent on continuing this kind of reading.

So there has gradually come to exist a considerable general awareness of the fact that insect life is a peculiarly interesting sort of life, and that it is an excellent example of behavior determined almost entirely by instinct, that is, by an inherited capacity, present from birth and but little modifiable by education or experience, to do extraordinary and complicated things connected with food-finding, protection from enemies, mating, egg-laying, care of young and whatever other things are necessary to maintain life and to perpetuate the species under most various conditions.

Now if any one, entomologist, general zoologist or layman, would like to be able to turn to a single book in which a large range and variety of insect behavior are brought together, simply described and treated analytically with the aim not primarily of telling interesting stories, but of getting at a more fundamental understanding of the springs and control of instinct, I know of no book which can be more confidently recommended to meet this desire than the book in hand. The author, E. L. Bouvier, professor at the famous Museum of Natural History in Paris, and the translator, Dr. L. O. Howard, chief of the U. S. Bureau of Entomology, are both outstanding authorities on insects, and both can write clearly and interestingly, so the book is at once reliable and lucid. If, after reading it, you are impressed more than ever, despite the book's aim of analyzing and classifying "the psychic life of insects," with the amazing complexity and wonder of this life, this is only because the more one learns about it the more one truly realizes how amazingly complex and wonderful it is.

Proceeding from a consideration of the simpler, more rigidly mechanical, and hence more readily explained kind of insect behavior—more readily explained, that is, at least as far as relation between stimulus and reaction is concerned—the author moves on to a consideration of more elaborate and complex insect habits, reaching finally the highly specialized habits of the social wasps, bees and ants, often referred to by entomologists as the "highest" insects.

Despite a strong tendency to favor a mechanistic explanation of insect behavior wherever this seems at all possible, the author is forced by the impressive seeming of an element of intelligence and reason in such specialized and complex behavior as that shown by the social insects and other less familiar but hardly less wonderful ones to assume a position with regard to the origin of this behavior which aligns him squarely with the believers in the Lamarckian evolution factor of the inheritance of acquired characters. For Bouvier assumes that much of this highly specialized insect behavior must have been originally acquired by the use of intelligence and then so often repeated as to become an inherited species habit, hence an instinct. To accept such an explanation requires two assumptions that many biologists can not accept: namely, an assumption of a considerable degree of intelligence in insects and an assumption of the possibility of the inheritance of acquired characters.

But the general reader of the book need not worry

about these things. He can well leave this worry to the biologists, and simply enjoy and muse over the amazing and fascinating wonders of life among the lowly as they are reliably and clearly described by author and translator.

Vernon Kellogg

Washington, D. C.

SPECIAL ARTICLES

ON ABUNDANCE AND DIVERSITY IN THE PROTOZOAN FAUNA OF A SEWAGE "FILTER"*

I

Enumerations made of the animal population of the "film" held among the broken stone of a sewage purification "filter" of the intermittent sprinkling type have given data for a quantitative account of the associations and seasonal successions of these forms.[1] The abundant protozoan fauna exhibits a peculiar relation between the total number of organisms of any one class and the number of its genera then represented in the sample. Under natural conditions the abundance of organisms of any one type found in a given situation at different seasonal periods is in a general way inversely proportional to the diversity of their kinds. This phenomenon is well recognized in plankton studies and is demonstrable in published counts of organisms occurring in polluted streams.[2] In the sewage film there is on the contrary a direct correlation between number of rhizopod individuals or of ciliate individuals and the corresponding numbers of their genera. The ethological significance of such relationships seems not to have been investigated. Obviously, they are important for the problem of specific adaptation; and in this connection they suggest a means of estimating the comparative selective stringency of environments.

II

Samples of "film" were obtained from the surface and from three levels within the filter-bed, by means of a centrally-located sampling-pit analogous to that described by Johnson.[3] The figures given are the average numbers of organisms calculated present in one cubic centimeter of centrifuged fixed film material;[4] counts[5] of organisms from the three interior levels of the bed have been averaged, the surface layer being omitted. The detailed findings will be presented in another place.

Except for an interval during summer, peritrichous, hypotrichous, and holotrichous ciliates are present in abundance. Two well-defined maxima occur in the frequency of these forms, one in Nov.–Dec., the other in May–June (1921–22). These maxima correspond, in a general way, with the seasonal distributions evident in less artificial environments. When conditions in the filter permit ciliates to flourish, a variety of their species is likewise permitted. The attached peritrichs (chiefly Opercularia), whose numerical increase is subject to somewhat different mechanical conditions, are omitted from the totals plotted in Figure 1. The graph (Fig. 1) shows that with certain minor

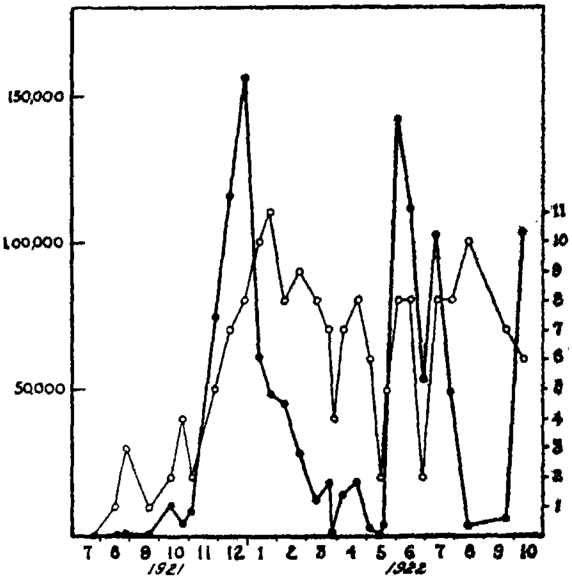


Fig. 1. Mean number of non-peritiuchous ciliates per cubic centimeter of ''film'' in bi-weekly samples, July, 1921, to Oct., 1922 (heavy line, ordinate scale at left). Corresponding numbers of genera (light line, ordinate scale at left).

deviations of special origin, the abundance of non-peritrichous ciliates (number of individuals per cubic centimeter of "film") varies directly with the diversity of their kinds (number of genera).

A similar relation is even more precisely shown in the rhizopod fauna. The seasonal distribution of the

* Paper No. 121 of the Journal Series, New Jersey Agricultural Experiment Stations.

[1] *Cf.* Crozier, W. J., and Harris, E. S., 1923, Ann. Rept., N. J. Agr. Expt. Stns., 1922 (in press); 1923, *Anat. Rec.*, Vol. 24, p. 403.

[2] *Cf.* data of Weston, R. S., and Turner, C. E., 1917, Contrib. Sanit. Res. Lab., Mass. Inst. Tech., Vol. X.

[3] Johnson, J. W. H., 1914, *Jour. Econ. Biol.*, Vol. 9, p. 105–124; 127–164.

[4] In the fresh, uncentrifuged film the numbers per cubic centimeter are about one half as large. The film (also studied alive) was fixed in mercuric chloride solution before counting the organisms in a unit volume of the diluted film.

[5] The collaboration of Mr. E. S. Harris in making the enumerations is gratefully acknowledged.

rhizopods, shows a single maximum (Aug., 1921; 1920).

The nature of the connection between abundance and diversity, in the case of rhizopods and of (non-peritrichous) ciliates, is brought out in Figure 2.

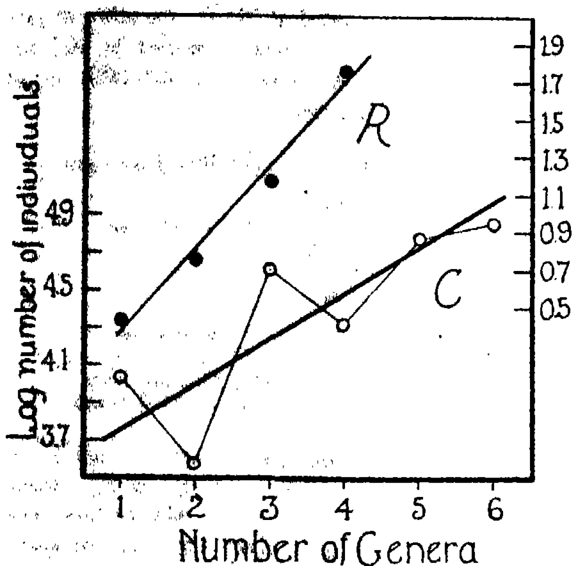


FIG. 2. Mean numbers of individuals correlated with number of genera they disclose; *R*—rhizopods; *C*—Holotrichous ciliates. (In the latter case, *C*, the period of vernal re-organization of the film, "sloughing," is excluded.)

The number of genera represented is a linear function of the logarithm of the corresponding average number of individuals.

III

From these results it may be argued that the sewage filter film is an environment of essentially artificial quality, for the relation between abundance of individuals and diversity of type is the reverse of that detected in situations lacking so plentiful a food supply for the growth of these organisms. It is to be presumed that under natural conditions the character of various specific adaptations plays a significant, even a determining rôle in survival and multiplication. Hence the view that if any one species initially present be the most suitably adapted in an environment sufficiently selective, this form will show greatest number of individuals. Whereas, if the integrated environmental effect be on the whole inimical to organisms of a particular group, a few of its species may be represented, but no one of those in especial specific selective restraint, for here diversity is at frequency. It follows that when conditions in the sewage filter "film" permit ciliates or rhizopods to flourish, there is interposed, broadly speaking, no maximum simultaneously with density of population. In all probability, therefore, temperature and gross mechanical circumstances, rather than food, limit the quantities and proportions of these particular organisms in the "film." This is consistent with the view that they are in the main subsisting upon bacteria[6] rather than directly upon putrescible constituents of the sewage.

IV

Certain difficulties interfere with the development of hypotheses concerning the meaning of specific diversity. We may safely accept the view that failure of a given type to survive in a specified location is evidence for its absence of suitability. Considering closely related types, as different genera of one order, it should be possible to obtain for different environments the curve connecting the abundance of these creatures with their corresponding diversity of forms, by means of analytic enumerations covering a period of a year or more. The widely distributed and rapidly multiplying protozoans are admirably suited for such investigation. According to the viewpoint here advanced, it should be possible to compare in this way the selective stringency or "selective potential" of different environments (with respect to the group of organisms considered). In the case of sewage "film" it is clear that environmental stress at times tends to eliminate rhizopods or ciliates, but that it is the general *kind* of creature, rather than particular species of it which is in this way suppressed. Such an environment has for these organisms no specific selective potential; the adaptive peculiarities of the species are not called into play in determining survival.

SUMMARY

In the film of organisms and débris retained among the broken stone of a sewage purification filter it is found that ciliate and rhizopod protozoans show seasonal variation in abundance of individuals and a directly correlated fluctuation in diversity of their types. An inverse correlation is recognized in natural environments of greater selective stringency. Such relationships may provide a basis for comparing the "selective potentials" of different environments.

W. J. CROZIER

ZOOLOGICAL LABORATORY,
RUTGERS COLLEGE

[6] This is of course to be expected; but it has sometimes been suggested that the abundant animal life of the filter film "must" contribute to purification of the percolating sewage. It is apparent, however, that in the filter food is probably never a limiting factor for these animals, even when purification is at high efficiency.

LONGEVITY IN SPORES OF ASPERGILLUS ORYZAE AND RHIZOPUS NIGRICANS

Rather frequent reference may be found in literature dealing with the cryptogams to the belief that spores will "live for years," but when actual foundation for the truth of such statement is sought for, it is surprisingly scarce. Little seems to have been done in the way of definite, properly controlled investigation of this point, under conditions which would preclude all possibility of error in the final conclusions. It was, therefore, felt that an account of the study herein reported might be worth while if for nothing more than to bring out similar reports possibly known to other workers.

Wehmer[1] has recorded germinating dried spores of Aspergillus species as follows: *A. Wentii*, after more than a year; *A. niger*, about three years; *A. oryzae*, more than four years. Brefeld[2] found viability in *A. flavus* after six years; Eidam[2] in *A. fumigatus* after ten years; and Hansen[2] in *A. glaucus* after sixteen years. But in these cases the data are not given clearly enough to entirely exclude possibility of chance growth.

The organism considered in this study is a well-known species of the Aspergillaceae, *Aspergillus oryzae*. The conidial material in question was collected in 1897 from cultures of this mold—sifted out with the dust from a container in which it had been grown upon a bran base, and had been allowed to become thoroughly air dry. It was placed in a tube 10 x 100 mm, which was sealed at that time and kept in the dark under ordinary laboratory range of temperature. No attempt was made to secure a vacuum, but the tube was two thirds full of spore-dust and was sealed in the flame, hence there would be, at the most, only a very small amount of air left within.

In November, 1919, after a lapse of twenty-two years, the tube was opened for testing. Since it was considered doubtful whether the spores would show any signs of life after such prolonged desiccation, inoculations were made upon a great variety of media. Plantings were made (a) direct from the tube, (b) from dextrose-bullion suspension, after "soaking" several hours. Transferring was done, with every precaution against accidental contamination, under a glass cubicle two feet high, 36′ x 24′ at the bottom, 36′ x 12′ at the top, the sloping front plate being adjusted to any height desired above the worker's hands. The base of the cubicle is also of glass; hence the whole structure may be readily disinfected. As a further precaution, half a dozen Petri plates of nutrient agar were exposed on the floor of the cubicle while the material was being removed from the tube. All plates remained sterile but one, upon which appeared a colony of "hay" bacillus.

The following media were inoculated in duplicate, one series being incubated at 37° C., the other at laboratory temperature. In general, it may be said the higher temperature is rather more favorable or at least hastens development.

(1) Sabouraud's agar (American ingredients)	(7) Rice flour agar
(2) Czapek's agar (Formula as modified by Dox. Cane sugar the source of carbon)	(8) Wheat bran
(3) Plain gelatin	(9) White rice
(4) Sugar gelatin	(10) Brown rice
(5) Dextrose-bouillon	(11) Cracked corn
(6) Potato agar	(12) Cracked beans

Cultures of varying degrees of vigor were obtained, the organism developing upon every medium tried, much more luxuriantly, however, where there was abundant starch or sugar content, 4 per cent. or more, readily available. Considerable range in height of upright hyphae, color and size of conidial heads, etc., was found upon the various substrata; but these proved to be interchangeable according to the food, *e.g.*, when transferred from No. 3 above to No. 8, growth was comparable to that upon other cultures of No. 8 and vice versa.

On the whole, this strain can not be seen to have lost ground either in the development of typical herbage or in physiological activity. It is a vigorous diastase producer, and exhibits considerable proteolytic power as well. Since 1919 it has been maintained in pure culture upon three of the above media: Czapek agar—Dox modification; Sabouraud's formula prepared from American ingredients; and rice flour agar. It is still a thrifty strain.

The tube of spore-dust was resealed, to be kept indefinitely.

Rhizopus nigricans. In the course of the above work, although quite unintentionally, longevity was also demonstrated in another organism—the common *Rhizopus nigricans*, cultures of which were several times obtained from the tube of spore-dust where it had doubtless found entry as an invader of the original culture. Only one strain was preserved and has since been kept in culture. This, tested a year or two ago against Blakeslee's minus strain, proved to be of the plus type.

Adelia McCrea

Parke, Davis and Company,
Detroit, Michigan

[1] Centralblatt für Bakt., 2 Abt., 1897.

[2] Cited by Lafar: "Technical Mycology," Vol. II, Part I.

THE NATIONAL ACADEMY OF SCIENCES

At the autumn meeting, held at Cornell University, Ithaca, N. Y., the scientific program was as follows:

MONDAY, NOVEMBER 12

Morning Session

Welcome by President Farrand.

Some unexpected results of the heteroplastic transplantation of limbs: ROSS G. HARRISON.

The structure of the eye as an index of developmental deficiencies: CHARLES R. STOCKARD.

Some seasonal variation of vitamines: GEORGE W. CAVANAUGH (introduced by L. H. Bailey).

The effect of X-rays on the linkage of Mendelian characters: JAMES W. MAVOR (introduced by W. E. Castle).

Electrical resistance and thermo-electric power of the alkali metals: C. C. BIDWELL (introduced by Ernest Merritt).

Evening Session

Public Lecture, under the joint auspices of the Academy and the Alpha Chapter of the Society of Sigma Xi.

The origin and distribution of Andean bird life: FRANK M. CHAPMAN.

TUESDAY, NOVEMBER 13

Morning Session

Biographical notice of Henry Marion Howe (by title): GEORGE K. BURGESS.

Stereoisomeric styryl derivatives of some 4-quinazolone alkyl iodides and their bearing upon the problem of photosensitizing dyes: M. T. BOGERT and HELEN CLARK.

The expansion of a frequency function and some comments on curve fitting: EDWIN B. WILSON.

Note on an experimental problem of the late A. G. Webster: F. L. HITCHCOCK (communicated by Edwin B. Wilson).

On the wave-lengths of scattered X-rays: GEORGE L. CLARK and WILLIAM DUANE.

Unimolecular films of adsorbed gases: HUGH S. TAYLOR (introduced by G. A. Hulett).

Germanium: L. M. DENNIS (introduced by W. D. Bancroft).

Halogenoids: A. W. BROWNE (introduced by W. D. Bancroft).

Substantive dyes: T. R. BRIGGS (introduced by W. D. Bancroft).

Structural colors in beetles: C. W. MASON (introduced by W. D. Bancroft).

Afternoon Session

Retarded effectiveness of introduced parasites: L. O. HOWARD.

A theory as to long-time pandemic cycles of influenza: OTTO R. EICHEL (introduced by Raymond Pearl).

Metallic luster: W. D. BANCROFT.

WEDNESDAY, NOVEMBER 14

Morning Session

Presentation of Scientific Papers.

Biological studies of the Bremidae (by title): THEODORE H. FRISON (introduced by Stephen A. Forbes).

The paleobotany of the island of Trinidad. A preliminary announcement: EDWARD W. BERRY.

An aberrant F_2 ratio for the starchy-sugary endosperm factor pair in maize: R. A. EMERSON (introduced by L. H. Bailey).

The photo-luminescence of flames: EDWARD L. NICHOLS.

The effect of temperature on X-ray absorption coefficients: H. S. READ (introduced by Ernest Merritt).

Resistance temperature coefficients of thin platinum films obtained by kathodic sputtering: F. W. REYNOLDS (introduced by E. L. Nichols).

THE AMERICAN CHEMICAL SOCIETY

DIVISION OF CHEMISTRY OF MEDICINAL PRODUCTS

SYMPOSIUM: *The Chemistry of Glandular Products:* E. C. KENDALL, *Thyroxin;* T. B. ALDRICH, *Adrenalin;* H. A. SHONLE, *Insulin;* FRANK O. TAYLOR, *Pituitary extract.*

A study of the sodium salts of nucleic acid: ADRIAN THOMAS. The sodium nucleates were prepared from a nucleic acid obtained from wheatgerms. The acid was dissolved in solutions of sodium hydroxide and precipitated by pouring into alcohol, to which had been added some neutral sodium acetate to prevent emulsification. Sodium nucleates were prepared containing as a maximum eight atoms of sodium, assuming the molecule to contain four atoms of phosphorus. If potassium acetate is used in place of the sodium acetate some of the sodium is replaced by potassium. Upon using ammonium acetate instead of sodium or potassium acetate a decrease in the sodium content of the salt is found, but only a part of the sodium which is lost is replaced by ammonium. Apparently a hydrogen-sodium-ammonium salt is formed.

Butesin picrate, a new type of anesthetic-antiseptic: F. K. THAYER. Butesin picrate is the picric acid salt of butyl paraminobenzoate. There is combined in a definite chemical compound both antiseptic and anesthetic action. In an aqueous solution with a concentration of 1 part in 1,400 it produces immediate and complete anesthesia upon the eye, which lasts from ten to twenty minutes. It exerts antiseptic action and, in many cases, germicidal action against various common bacteria, in concentrations of 1:400 to 1:800. Butesin picrate is non-toxic and not irritating to the most sensitive surfaces. Incorporated into an ointment it is useful in the treatment of painful, denuded skin areas, particularly in cases of burns.

The synthesis of new cinchophen (atophan) types and incidental compounds (by title): MARSTON T. BOGERT and F. P. NABENHAUER. Cinchophens containing the quinazoline nucleus have been synthesized as follows: (1) o-aminoacetophenone to o-acetamino acetophenone, to acetyl isatinic acid, to 2-methylquinazoline-4-carboxylic acid; (2) isatine to benzyl isatinic acid, to 2-phenylquinazoline-4-carboxylic acid (A); (3) o-phthaloylamino acetophenone to phthaloyl isatinic acid, to 2-(o-carboxyphenyl) quinazoline-4-carboxylic acid (B). Of these, (A) is strictly analogous structurally to Cinchophen, except that it carries the Ph and COOH groups

on a pyrimidine instead of a pyridine nucleus. (B) resembles (A), but carries an additional COOH in o-position on the 2-Ph group. The physiological effects of these new compounds are being tested. Incidentally, many new intermediate and related products were also prepared and will be described in the published article.

The antiseptic action of the zinc chloride salt of aniline: J. W. HOWARD and F. D. STIMPERT. This salt was prepared by combining zinc chloride and aniline in molecular quantities and extracting the reaction mixture with boiling 95 per cent. alcohol. Softens at 230° C, melts at 255° C. Solubilities: at 20° C, 0.64 grms. in 100 cc H_2O; 0.87 grms. in 100 cc 0.4 HCl; 0.066 grms. in 100 cc 95 per cent. alcohol. V. slightly sol in CS_2, $CHCl_3$, C_6H_6, $(C_2H_5)_2O$. More sol. in CH_3OH and acetone. Slowly decomp. by 3N Na_2CO_3, readily by 1N NaOH or boiling H_2O. Studies on Staphylococcus aureus indicate aniline has about 5 times the disinfectant power of $ZnCl_2$. The salt $(C_6H_5NH_2)_2$ $ZnCl_2$ in 0.6 per cent. soln. retards growth up to 25 mins. and will destroy in 30 minutes. Comparing with aniline and zinc chloride of the same conc. it shows a stronger antiseptic action.

Some chemical reactions of the pancreatic substance containing insulin (lantern): HORACE A. SHONLE and JOHN H. WALDO. The pancreatic substance containing insulin gives, after thorough purification, the following reactions: Biuret, xanthoproteic, Millon's, Ehrlich's diazo, reduced sulfur and Folin and Looney's reaction for tyrosine and cystine. The Molisch and glyoxylic reactions are negative. Neither phosphorus nor purines can be detected and the amino acid content is very low. This substance is soluble in dilute acids and alkalies. Its solution is laevo rotatory. The physiologically active portion dialyzes slowly through parchment paper, and can be precipitated by protein precipitants in such a state that it usually can be recovered from the precipitate. The C, H and N content of the purest preparations approximates that of protein. The data secured indicate that the active principle is either a proteose or that it is closely bound to a proteose.

Studies of the vitamin potency of cod liver oil—VII—The potency of hake liver oil (lantern): ARTHUR D. HOLMES. To secure data concerning the relative vitamin potency of cod and hake liver oils, tests were made of hake liver oil known to be true to name. Nine young albino rats were given hake liver oil in amounts varying from .00025 grams to .005 grams daily. Four animals received less than one milligram of oil daily and failed to recover from vitamin A starvation. Five animals received from one to five milligrams of hake liver oil daily and recovered, indicating that one milligram of this oil contained sufficient vitamin A to promote growth of young albino rats.

E. H. VOLWILER,
Secretary

SECTION OF THE HISTORY OF CHEMISTRY

F. B. Dains, *chairman*

Lyman C. Newell, *secretary*

Robert Brown and the Brownian movement: LYMAN C. NEWELL. Robert Brown (1773–1858), a Scotch botanist, discovered the movements of minute particles, now called Brownian movements, in 1827 while viewing a water suspension of pollen grains through a simple microscope. Impressed by this observation, he extended his investigation to suspensions of various substances—inorganic and organic, and proved that the movements are not due to anything living in the water nor to currents caused by convection or evaporation, but are fundamental and inherent in the particles. His investigation was first published in the *New Edinburgh Philosophical Journal*, Vol. 5, April–September, 1828, pp. 358–371.

Gulian C. Verplanck's account of alchemy in old New York: C. A. BROWNE. Dr. Browne says very correctly "that within the past few years a sufficient amount of documentary and literary material has been gathered together in different quarters to prepare a volume of considerable size upon the history of alchemy in America," and in the present communication he narrates in a delightful way what he discovered upon ruminating in a publication entitled the "Talisman" for the year 1829. It is the story of Max Lichenstein, who actually conducted a "transmuting laboratory" down in Wall Street, New York. No one would have dreamed such a thing possible, but it was, until he saw fit to migrate, and, adds Verplanck, "I have heard that his furnace has again been seen smoking behind a comfortable stone house in the comfortable borough of Easton, Pennsylvania, a residence which he chose, not merely on account of its cheapness of living, nor its picturesque situation, but chiefly for its neighborhood to Bethlehem, where dwelt a Moravian friend of his, attached to the same mysterious studies."

Ten minutes with the ancients: EDGAR F. SMITH. In this communication attention was called to several famous paintings of eminent alchemists. Pictures of men who traveled through Europe in the interests of alchemy were exhibited, and also the title page of a very famous volume, devoted to alchemy, by Carbonarius, was shown. It was explained how very helpful this publication would be to students of the present who had the inclination and desired to acquaint themselves with the writings of the so-called genuine practitioners of the art of transmutation.

Jacob Green—chemist: EDGAR F. SMITH. This paper records the life-work of a forgotten American chemist who taught his science in Princeton University for four years (1818–1822), and in 1825 became one of the founders of Jefferson Medical College where he was the first professor of chemistry (1825–1841). Green was a splendid example of the old-fashioned, broadly trained teacher. He made worth while contributions in botany, paleontology, natural history, physics and chemistry. His "Chemical Philosophy," in 1829, presented the fundamentals of chemistry in a remarkably lucid fashion. In fact, all of Green's books exhibit his complete grasp of his subject. His interviews with Dalton, Faraday, Gay-Lussac and other sciencific worthies are most illuminating. Green was a superb teacher of chemistry.

Some notes on a "reader of chemical history": EDWARD KREMERS.

LYMAN C. NEWELL,
Secretary

SCIENCE

VOL. LVIII NOVEMBER 30, 1923 No. 1509

CONTENTS

SCIENCE: A Weekly Journal devoted to the Advancement of Science, edited by J. McKeen Cattell and published every Friday by

THE SCIENCE PRESS

Lancaster, Pa. Garrison, N. Y.

New York City: Grand Central Terminal.

Annual Subscription, $6.00. Single Copies, 15 Cts.

SCIENCE is the official organ of the American Association for the Advancement of Science. Information regarding membership in the association may be secured from the office of the permanent secretary, in the Smithsonian Institution Building, Washington, D. C.

Entered as second-class matter July 18, 1923, at the Post Office at Lancaster, Pa., under the Act of March 3, 1879.

CHEMISTRY AND MODERN LIFE[1]

IT is my privilege to address you upon this important and auspicious occasion—the opening and dedication of the magnificent chemical laboratories created by the munificence of your generous and far-sighted donor, Mr. Jesse H. Metcalf. It is a gift which will have far-reaching consequences and which will exert influences that will continue to increase and broaden after we ourselves have gone.

Let me consider with you the purpose which these buildings will serve and the position which chemistry and science in general bid fair to attain in the life of mankind.

A chemical department flourishes most when side by side with strong departments of all faculties. It must be filled with the spirit of humanity, its teachers with the spirit of research. They should be a body of men whose zeal for knowledge and desire to increase it are principles of life; and its teaching should be such as to fit the student to be his own teacher and to continue the study of his subject on his own account after he has taken his degree.

Next to personnel comes the necessity for equipment. This is a factor which is seldom adequately taken into account and upon which it is impossible to lay too much stress. Lack of equipment means that work is stultified or crippled and that a building, however good, may become an empty shell; whereas with it the possibilities of the future are infinite.

Again it is perhaps not generally appreciated that a well-furnished library is as indispensable to workers in science as to those in any other faculty. Indeed, there are but few scientific theories whose significance and limitations can be fully understood without some idea of their historical development, which is only obtained by access to the original literature. This is frequently in a foreign language. Mere text-books appear dogmatic and infallible, and the more intelligent student rebels or may be repelled. It is when he turns to the original record that the subject becomes alive. Doubts are fairly met instead of being repressed, the exact implications and possible lines of extension are much more clearly seen.

May I remind you that chemistry has now become a vast subject far beyond the power of any one man, however gifted, to grasp. There are about 40,000

[1] Address delivered at the dedication of the Jesse Metcalf Chemical Laboratory, Brown University.

papers and contributions recorded in the chemical journals each year. Nevertheless, so infinite is nature that it is possible for any one with a general knowledge of the subject to possess himself, within a few months, of all the recorded knowledge on any selected topic. Again so extensive are the ramifications of chemistry and its applications that the number of workers of any scientific standing in any given subject, whether of scientific or industrial importance, is very limited. Truly, the laborers are few although the fields are white unto harvest.

The final requirement for a chemical department is that it should have some direct touch with industry. This brings more reality into academic laboratories which are too apt to be dominated by text-books and examinations, and it gives a better professional training. In the words of the report of the British Government's Privy Council for Scientific and Industrial Research:

> Pure science has in the past owed much to observations, suggestions and difficulties which have come from activities external to the laboratory or study. So will it be again, and it is our desire so to order the relations of workers in pure science to the industries going on around them that they may receive the stimulus of a wider outlook. In this way it may be possible in the end to create such an atmosphere that the new generation of students will cease to draw the distinction between "theory" and "practice," and technologists of all ranks will through them attain to the view that sound practice is only theory tempered by compromise.

This *liaison* "ensures the continued contact of the research worker with advanced students—an inestimable benefit in the opinion of all the best authorities. Finally, it enables us to use to the utmost advantage the very limited number of original workers available whether for research or for teaching."

The study of chemistry is but part of the work of a university, an institution which is one of the vital organs of a healthy community. A university has a duty towards and is owed a duty by society, both resting, as they do, upon the need for mutual sympathy and understanding.

This brings us to a consideration of the place that chemistry occupies in modren life. Chemistry is the science of the transformation of matter, lying at the basis of all human industry and of such applied sciences as agriculture and medicine. It is so enormously productive, both of new knowledge and of applications, that this aspect may overshadow its real scientific value. My own part of the subject, namely, physical chemistry, can be defined in two or three words—it is the study of the laws of chemistry. Chemistry during the greater part of its development has been the science of analyzing matter.

We realize that when we can take a thing apart we may be able to put it together again and put the parts together in a way superior, for our purpose, to the original arrangement. I need not labor this aspect of the subject, for I understand that you have heard an address by a very able exponent, Dr. Slosson, on "Creative chemistry." During the last fifty years the study of this science has produced numberless new products which had never appeared in nature before and which have proved of great value to mankind. I do not wish, however, to lend support to the false impression, which is only too current, that chemistry is a kind of black magic. On the contrary, the modern chemist tries to plan a reaction just as an engineer plans a bridge, with the same deliberate design and sustained purpose.

I wish to call your attention to an example taken from the ammonia industry which will illustrate the importance of the study of theory and of pure laboratory experiments. It is natural that I, coming from Bristol, should select this example of the fixation of nitrogen, for it was in Bristol that, in 1899, Sir William Crookes pointed out that the world's food supplies are dependent upon a supply of nitrogenous fertilizers to the soil.

Each crop takes so much out of the soil that unless this essential material is replaced the yield per acre steadily drops. There is an inexhaustible store of nitrogen in the air, but nitrogen as such is one of the most inert of materials. It is only when it has been made to combine with other elements, such, for example, as hydrogen, that it becomes available as plant food. The problem in this case consists in taking from the two abundant sources, air and water, the constituent nitrogen and hydrogen and combining them in the form of a new substance, ammonia.

At the beginning of the present century there was no known method for any such fixation of nitrogen, but as the result of applying pure research there are already many industrial methods of fixing nitrogen in actual operation on a very large scale. We shall now trace in outline the manner in which this great result has been achieved in the important instance I have mentioned, the synthesis of ammonia.

Thermodynamics supplies two of the most fundamental laws of science. The first law is that we can not get perpetual motion, we can not get work for nothing. The second law is that all spontaneous processes (and only these) may be utilized to give work. There is nothing more beautiful than watching the operation of these universal laws, quantitative in their application and as universal as the law of gravitation. They are examples of what Einstein calls "theories of principle," whose charm lies in their logical perfection.

On applying these laws to chemical reactions your famous Willard Gibbs, followed by van't Hoff and

others, obtained a mathematical relationship called the Mass Law. This law revealed that it was within the power of the chemist to make the reaction $3H_2 + N_2 = 2NH_3$ go in whichever direction desired, for the effects of changes in such factors as pressure and temperature could be predicted. The first problem was to find the most suitable equilibrium.

Production of ammonia is increased by the application of 200 or even 1,000 atmospheres' pressure. The next problem to be solved was the regulation of the temperature to give the most satisfactory yield. The ammonia must be produced at a practical rate and to bring this about substances termed "catalyzers" are employed to hasten the reaction and in addition materials called promoters have been discovered which have the property of still further increasing the efficiency of the catalyzers. The explanation of the action of such catalyzers illustrates what Einstein terms theories of "construction," whose fascination lies in the simple but ingenious mechanism they reveal.

By applying all these principles the Germans have already succeeded in producing ammonia at the rate of over 1,000 tons a day. Thus, from the knowledge obtained by pure theoretical and laboratory research there has been achieved a result which is vital to the existence of the white population of the world and in this instance essential also for war. Further progress has been made in several countries, and commercial production has begun in England and the United States. Furthermore, concurrently with the development of the direct synthesis of ammonia, other alternative methods have been worked out on the largest scale for the fixation of nitrogen in various forms, and all within twenty years of Crookes' first challenge.

Time lacks for further specific illustration, but I wish to bring before you some more general considerations with regard to science. Pure science is study, and incessant effort to understand, testing every idea by the touchstone of truth. For its pursuit the chief requirement is character. This must be reinforced by enthusiasm and imagination. Constructive imagination must have the fullest play, and it is really surprising to see how difficult it is to liberate our minds from preconceived notions. Finally, it is essential that every conclusion must be rigorously tested and verified by honest experiment.

The results appear as a simplification or limitation of the conceivable possibilities. For instance, the whole material universe appears to be built up from perhaps only two constituents arranged to form fewer than 100 elements, and these are combined in accordance with immutable laws. Sometimes an advance in science is made by the boldest flights of the imagination, at other times it turns on increasing refinement of measurement. There is room for the most varied types of men, provided that they are devoted to the service of truth. Indeed, it is rare for any discovery to be the work of one unaided individual. Most great advances are cooperative, usually they are international, and without free international exchange of ideas, progress is crippled.

The value of refined measurements is so great that I should like to stress what has been pointed out before, that the laboratory that buys a refined scientific instrument is purchasing the thought and skill of all the preceding investigators who made the instrument possible and of the mechanics that brought it into being, thus involving and bringing to bear a great quantity and variety of skill and labor. Such weapons are clearly essential in all scientific laboratories; it is obvious that they will always be expensive and that there will never be finality in the case of any single instrument, each will be improved as knowledge advances. This is an added argument for liberal endowments for equipment and materials.

During the war there was created at Shawinigan Falls in Canada a colossal plant utilizing water power comparable with that which is obtained from Niagara. From coal and limestone they managed to produce on an enormous scale substances like acetone, acetic acid and alcohol. Their proud boast was that these great chemical achievements were entirely the cooperative work of a group of men who were just ordinary chemists.

The chief characteristic of the truly scientific man is the research outlook, detachment of mind and habit of resource; for remember, a mere knowledge of facts or principles does not make a scientist. It is a very partial or even sham knowledge which does not see the implications of a subject and is unwilling to face the test of further crucial experiment. We must take to heart the candid and pregnant words of Faraday, who was one of the most successful experimenters and profound thinkers whom chemistry or physics has known:

> The world little knows how many of the thoughts and theories that have passed through the mind of a scientific investigator have been crushed into silence and secrecy by his own severe criticism and adverse examination, that in the most successful instances not a tenth of the suggestions, the hopes, the wishes, the preliminary conclusions, have been realized.

The central position in pure science is necessarily occupied by research, and a special responsibility rests upon the workers in this field to be single-minded in the pursuit of truth and careful in their acceptance of evidence. Results which are not communicable and not verifiable are not science. Whereas formerly a scientific theory might wait even for generations before any further attention was paid to it, nowadays

every advance in pure science is immediately seized upon and applied in the most unexpected directions. Illustrations might be found in any of our large chemical industries—as, for example, that of artificial silk. Or, again, observe how quickly the comparatively recent intangible electron theory has created wireless and its related industries. Even the newly discovered and not yet isolated element hafnium is already being applied in wireless valves. Or we might consider such discoveries as those of radium and insulin. Indeed, during the last twenty years, applications of science in medicine have added ten years to the average expectation of life. Every process we employ, every device and invention of which we take daily advantage in our factories is the result of some former, may be forgotten research.

Some seed corn must be returned if the future is to repeat the successes of the past. Knowledge is power, and it is through scientific knowledge that we gain control over nature.

However, it is not upon utilitarian grounds that we present the claims of science upon the educated community. I would quote the words of President J. E. Barton of our Bristol Rotary (a movement which came to us in England from you):

> The real world is not the world of material prosperity or lack of prosperity. The real world is the world of science and discovery, of art, literature, emotion and passion. These are the things which give color and texture to experience.

J. W. N. Sullivan in his "Aspects of Science" has rightly emphasized that scientific research is thoroughly human; it is at once tentative, imaginative and courageous. In science we find a sense of unlimited possibilities, of adventure and of exultant hope.

In such men as Kelvin and Newton and Willard Gibbs we find the modern prototypes of Aristotle and Archimedes. "Science again affords theories and objects of contemplation which are as delicate, as subtle, as harmonious as the dreams of Plato—and much better founded." Many scientific theories are objects of surpassing beauty. Their innate truth appeals as directly to us as that of a great work of art. It is in this sense that Dr. Norman Campbell has written that "science is the noblest of the arts."

Science is bound to become an integral part of the culture of the future. It is profoundly influencing our conception of the universe and of man's place therein. A liberal education must have some acquaintance with the trend of the new physics, chemistry, biology and psychology, for they are too obviously pertinent to all man's chief preoccupations to be ignored.

Many of the convictions which I have expressed are felt by all scientists, although we do not often care to voice them.

They underlie all our efforts in the training of our students, the primary object of university work.

I have tried to justify the statement with which I commenced that this far-sighted benefaction will have long consequences.

It is with these high hopes that we dedicate the Metcalf Chemical Laboratory of Brown University.

James W. McBain

Bristol, England

SOME ASPECTS OF THE RELATION OF SPECIES TO THEIR ENVIRONMENT[1]

The close relation between an individual plant or animal and its surroundings is strongly emphasized. It is recognized that the conditions under which it lives may affect its size, its form, its habits and its methods of reproduction. But the influence of the environment on the groups of individuals which we call species, while recognized, seems not to be given the weight that it deserves. It seems to me, at least, that the environment may play a greater part than is indicated by many of the current writers. While the germ plasm is no longer generally regarded as being as completely isolated and independent as set forth by Weismann, and while most workers recognize the action of the environment in cutting off certain individuals and so maintaining the characters of the species within certain limits, there seems to be a failure to recognize the extent to which external conditions determine that the species now living shall show the characters that they do show rather than some other characters. If this is true, if the collections of individuals which we call species show the characters by which we recognize these groups, not alone because of the inherent properties of their protoplasms, but also because of the molding action of the environment, does it not follow that we must assign to the environment a large share in determining the forms of the species as we recognize them to-day?

Many plants and animals, when transferred to new conditions, have changed their form and structure in response to their new surroundings. Criticisms of these results have usually brushed them aside with the statement that the descendants of these individuals return to their old form and structure when returned to the old conditions. These criticisms seem to fail to recognize the fact that the species show the form and structure which we describe as characteristic for them only under a particular set of conditions. We can not doubt that, if the conditions on the earth were different from what they are, we should have our plants and animals showing different groups of characters from those which they now show. In other

[1] Address of the retiring president of the Association of Virginia Biologists, Norfolk, Virginia, April 27, 1923.

words, we should have different species, as we recognize species, from those which we now have. Stockard, exposing the eggs of a marine fish, *Fundulus*, to sea water with the addition of certain magnesium salts and to some other substances, obtained developing young showing marked differences from the characters usually shown, notably the development of one-eyed fish. Sometimes this single eye was on the side of the head, and sometimes in the middle of the forehead, giving a cyclopean form. It seems that, in these fish, the two eyes will develop in their usual places if the eggs are exposed to untreated sea water, but that various modifications of eye development and location appear if the sea water contains an unusual amount of certain magnesium salts. If, now, the sea water regularly contained larger amounts of these magnesium salts, should we not have these unusual forms of the eye as the usual characteristics of the species? In that case, by removing some of the magnesium salt we should obtain "abnormal" forms bearing two eyes, one on each side of the head. We can not too strongly emphasize the fact that many of the so-called abnormalities are normal developments under particular conditions. This seems, upon consideration, to be self-evident, but, while admitted by the tongue, is, I believe, frequently ignored by the mind of many a present worker.

The periodicity shown by several different kinds of plants and animals is probably an example of the molding action of the environment on these organisms. The marine alga, *Dictyota*, has been found to produce its sexual cells periodically in all places where it has been studied, but it has also been found to have one type of periodicity in Europe, a second type on the coast of North Carolina, and a third type in Jamaica. Moreover, while showing the same type of periodicity in Wales, England, and Italy, it has a different time of fruiting in each of these regions. On the other hand, at the two widely separated localities where this alga has been found on the Atlantic coast of the United States, it fruits on the same days at both places. While we have not yet been able to analyze the factors concerned here, we can scarcely conceive of this result being obtained in any other way than by the response of the plant to the conditions of its environment.

The fact of the effect of the environment on species is, I believe, unquestionable, but the manner of its effect is open to indefinite discussion. We may conceive of this as acting solely by directing and molding the development of the individuals, suppressing certain capacities and bringing others to expression. It is undoubtedly true that every individual has more inherent potentialities than are ever brought to expression. On the other hand, an individual can never develop structures or habits for which it has no inherent capacities. If the fish used in the experiments of Stockard had not had the capacity to respond to the presence of increased amounts of magnesium salts they would not have shown any such responses to these salts. The question immediately arises, then, Can conditions of the environment alter the inherent potentialities of individuals and finally of the race? Can acquired characters be inherited? I am aware that it is unorthodox to present-day biology to even raise this question, but I do not believe that the final answer to it has been given. The term "acquired characters" seems to be used in two senses—one, in the stricter sense, referring only to those cases where the inherent capacities of the organisms have been changed; the other including the cases where the effects of the molding action of the environment are inherited by subsequent generations without the direct influence of these factors of the environment. In the one case there will have been an alteration by the changed environment of the inherent potentialities of the organisms, in the other case the inherent potentialities already present will simply be brought to expression. Conklin, in his treatment of heredity nad environment, limits the discussion of the inheritance of acquired characters to the inheritance of particular characters such as hypertrophied heart or loss of sight and uses the term "induction," for the continuance in later generations of other characters which have been produced in the parents in response to changes in the external conditions. He states:

> Probably such changes are not instances of true inheritance; they do not signify a change in the hereditary constitution but an influence on the germ cells of a nutritive or chemical sort comparable with what takes place when fat stains are fed to animals; the eggs of such animals are stained, and the young which develop from such eggs are also stained, though the germinal constitution remains unchanged. The very fact that the changed condition is reversible and that it disappears within a short time is evidence that it is not really inherited.

Such discussion seems to me to show too limited an interpretation of the results. It seems comparable with the discussion of the failure of mutilations to produce effects on subsequent generations. It is obvious that mere changes in the form of individuals exposed to new conditions do not indicate acquired characters. The conditions may have affected only the material of the body and not have reached and affected the germ cells. But when the offspring of such plants or animals, produced after the return of their parents to the original environment, continue to show these changes for one or more generations, are not these to be properly regarded as examples of the inheritance of acquired characters? Such effects can be transmitted only through the germ plasm, and their

appearance in later generations shows that the germ plasm has been affected and altered. The fact that the descendants of such individuals return to the original state upon their return to the original conditions would seem to indicate only that they have again shown their capacity to respond to a changed environment. We can not call either the original or the altered form normal, for each is "normal" to the particular set of conditions under which it develops. Moreover each form is capable of yielding descendants showing the parental characters only if the successive generations are maintained within the environmental range which produces that particular set of characters. In this sense we may regard the characters ordinarily shown by a species as being acquired, since these are maintained only under the conditions under which the species ordinarily lives and must, therefore, be regarded as developed in response to these conditions and impressed by these conditions on the germ plasm. A full description of a species should include not only the characters which we ordinarily recognize, but a statement of the conditions under which these develop, together with all other characters which the species may show under other conditions. Surely, the potential characters are as much a part of the species as the expressed characters. It is only the chance of the environment that makes one set of characters expressed and keeps another set suppressed and potential. We have not yet such a description of any species, but only when we have this can we believe that we really know the species.

As to the means by which the environment accomplishes its results we still know almost nothing. Results of great importance to this question will, I believe, be obtained in the future from careful experiments carried on for many years. I believe, for example, that the effect of use and disuse is still to be determined by a series of properly conducted experiments. For this the caves abounding in some parts of Virginia seem to offer an excellent opportunity to determine the manner in which many cave animals have become blind. Such work should be done under the auspices of some organization which could continue the studies with the necessary care for several decades or possibly centuries, but could be expected to yield results of fundamental importance and lasting value. Whether the environment can or can not produce new characters within a species, altering its inherent capacities, is still open to question. But, however this may be, we can not doubt that our species are what they are partly because of the molding action of the environment; and a true interpretation of the evidence shows, I believe, that, in many cases, the external conditions affect the germ plasm as well as the body material and consequently have their effects shown in a smaller or larger number of succeeding generations.

W. D. Hoyt

Washington and Lee University

GRANTS IN SUPPORT OF RESEARCH

The opinion seemingly is prevalent that research is inadequately supported in the United States of America and that small grants are especially difficult to secure. Undoubtedly it is true that larger resources could be used to advantage in the promotion of scientific inquiry. Nevertheless, it should be recognized that very large sums are now available for research and that numerous sources of small emergency grants exist.

This note is written chiefly because the opinion of many investigators appears to be at variance with the experience of committees on grants. The former tend to consider it either impossible to secure assistance or scarcely worth the effort. The latter, on the contrary, are frequently surprised by the scarcity of meritorious requests and the necessity of inviting or even urging investigators to present their needs. Not infrequently committees responsible for special funds are unable to make awards because of this dearth of applications.

The experience of the writer as one-time director of the Research Information Service of the National Research Council and as a member of the Committee on Grants of the American Association for the Advancement of Science convinces him that investigators too often are not familiar with even the more important sources of funds, and strangely careless about informing themselves and presenting applications which permit intelligent committee action. There seems also to be a reluctance on the part of some investigators to ask aid because of the possibility of refusal. This attitude is unfortunate alike for committee responsibility in the distribution of funds and for the progress of research. It is obviously and highly desirable that every investigator whose original work demands additional funds for its proper conduct make known his needs fully and convincingly to the officers of appropriate sources.

Although not all investigators may reasonably be expected to be familiar with the multitudinous sources and forms of support of research in this country, any intelligent and determined individual should be able to assemble pertinent information on need. The Research Information Service of the National Research Council two years ago issued a bulletin on "Funds available in 1920 in the United States of America for the encouragement of scientific research." This publication has been distributed widely and is still avail-

able to investigators who desire to utilize it. A revised edition is in preparation for issuance in 1924.

The Committee on Grants of the American Association for the Advancement of Science earnestly invites the attention of investigators to the fact that the Association distributes annually from four to five thousand dollars in small grants, usually of less than $500. The Committee often has too few applications for aid. It never has had too many good ones! This undoubtedly is the experience also of similar bodies. Whether or not available funds for small grants are entirely adequate, it is reasonably certain that existing funds are not being used to the best possible advantage because investigators do not take the trouble to get their needs before the administrators of appropriate sources.

In so far as possible the Research Information Service of the National Research Council will advise inquirers about possible and appropriate sources of support and will thus enable them to communicate directly with special committees or other bodies.

ROBERT M. YERKES,
Chairman

COMMITTEE ON GRANTS OF
THE AMERICAN ASSOCIATION

JACOB ROSENBLOOM

ON September 25, 1923, there died in Pittsburgh Dr. Jacob Rosenbloom, the eminent metabolist. In him America lost an ardent lover of science, and biochemistry a prominent contributor to its progress.

I met Dr. Rosenbloom thirteen years ago when he was twenty-five years old. At that time he was a living dynamo, working fifteen to eighteen hours daily in the laboratory on several problems in biochemical research simultaneously. His mind was one of the alertest that I have known. He constantly read the scientific literature published all over the world, and, with the most tenacious memory, retained and indexed his gleanings so that he could throw light at any moment on any problem in the very diverse fields of medicine and biochemistry.

His tastes were catholic. His reading was as diverse as literature itself. He spent very little time in the enjoyment of the trivialities of life. His laboratory and his library were his places of recreation and repose.

Dr. Rosenbloom was born in Braddock, Pennsylvania, on February 25, 1884. He received elementary and high school education in the local schools and then entered the University of Western Pennsylvania, from which he was graduated in the year 1905 with the degree of Bachelor of Science. His professor at the university was Dr. Francis Phillips, a man who has left his mark on American chemistry. Professor Phillips prophesied a brilliant future for Dr. Rosenbloom's chemical attainments, and he remained his friend and admirer until his own demise. From Columbia, Dr. Rosenbloom received the degrees of Doctor of Medicine and Doctor of Philosophy. Later on he was appointed biochemist in the Western Pennsylvania Hospital of Pittsburgh and assistant professor of biological chemistry in the University of Pittsburgh.

His specialty in medicine was the diseases of metabolism, and he was the first man in the United States to recognize such a specialty, to enter it and to find many imitators.

Dr. Rosenbloom was generous to a fault. His time, his purse and his labors were always at the command of his friends. One can conceive of the generosity of his mind when one is told that knowing that his time for research was limited, he published at his own expense a brochure entitled "1000 problems in biochemical research" and freely distributed it to his friends and enemies for them to grasp these suggestions and to work out these original thoughts of his.

He has contributed more than one hundred reports of original research to the various medical and biological journals of America, England and Germany. Those who have read his works will feel greatly the loss that science sustains.

Towards the later years of his young life, Dr. Rosenbloom devoted much time to the history of medicine and he had made several interesting contributions to that subject in the *Annals of Medicine* and in *Medical Life*. He has asked the author of these lines before he died, not knowing that he was going to die, to collaborate with him in the publication of a volume on "Critical Studies in the History of Medicine." This volume is ready and will soon be submitted for publication.

MAX KAHN

NEW YORK, N. Y.

SCIENTIFIC EVENTS

BRITISH AGRICULTURAL RESEARCH[1]

ROBERT HUTCHINSON, president of the National Association of British and Irish Millers, read a paper on "The Economic Basis of Wheat-growing in England" at the annual meeting of the fellows of the National Institute of Agricultural Botany on November 2. The only way, he said, of preventing the area under wheat from being further reduced was to raise the price to a profitable level. This is not impossible if a wheat is obtainable which combines with the productivity, the stiffness of straw and the resistance to disease of the best English wheats, the "strength" which puts so high a premium on the best Canadian wheats. "Strength" is the mysterious factor which

[1] From *Nature*.

determines the size, shape and palatability of a loaf. For many years it was believed that a strong wheat could not be grown on English soils or in the moist English climate. Wheats imported for experimental purposes from Canada, Russia, Hungary and Turkey all lost their quality within a few years. But one wheat, Canadian Red Fife, has been proved to retain its strength unimpaired after 21 successive years' growth in England. Professor R. H. Biffen, working on Mendelian lines, has proved that strength is a dominant characteristic, and by crossing Red Fife with high-yielding English wheats has already given the farmer Yeoman wheat, which without admixture of foreign wheats will yield satisfactory bread. But, in Professor Biffen's own words, the sooner Yeoman is off the market the better, for a series of new wheats believed to combine the best characteristics of Canadian and English varieties, and adapted to different types of soils, are now growing at the Cambridge Plant Breeding Institute, and it is hoped to market the first of these through the National Institute of Agricultural Botany in the autumn of 1924. If the promise of these wheats materializes, English wheat will be lifted from the category of kinds to be bought for breadmaking only when the price is low into the category of kinds desired and essential. This change would revolutionize the financial prospects of English wheat-growing.

Of recent years the great development of agricultural education and research in Great Britain has attracted considerable attention throughout the empire. The number of research workers spending some time at centers such as the Rothamsted Experimental Station is rapidly increasing. In the majority of cases they are sent officially by the dominion government concerned. A further example of this cooperation is furnished by the recent departure of Sir John Russell, director of the Rothamsted Experimental Station, on a special mission to the Sudan. He will be associated with Dr. H. Martin Leake, director of agriculture for the United Provinces of India, in advising the Sudan Government on its agricultural policy. In view of the enormous possibilities for growing cotton in the Sudan, agricultural research work will be mainly concerned with cotton. The first instalment of the great irrigation scheme in the Gezira plain south of Khartoum is expected to come into operation in the autumn of 1925. At this stage 300,000 acres will be put under irrigation, of which 100,000 acres will be under cotton; but the total scheme is capable of development over an area of 3,000,000 acres. In approaching Sir John Russell and Dr. Leake, the Sudan government has been actuated by the desire to get the best possible advice as to the organization and direction of the agricultural research work which should be undertaken in connection with this project, which may ultimately produce 1,000,000 bales of cotton a year. It is hoped that the Empire Cotton Growing Corporation will cooperate with the Sudan government in the research work to be carried out, and that this work can be coordinated with a general plan for research work on cotton problems to be organized throughout the British Empire.

BRITISH EXPEDITION TO SAMOA

THE research expedition arranged by the London School of Tropical Medicine, which is going out to Samoa to study the prevention of filariasis and associated diseases, especially elephantiasis, according to the London *Times*, has left Southampton in the *Athenic* for New Zealand, *via* Panama.

It consists of Dr. P. A. Buxton, the well-known zoologist, entomologist and medical man; Mrs. Buxton and Mr. G. W. Hopkins, of Downing College, Cambridge. In New Zealand, they hope to add to their company one or two New Zealand medical students, who will thereby be given opportunity of studying some of the problems of disease which the government of their dominion will have to face in connection with its mandate over such areas as Samoa.

It is hoped to be able to demonstrate that the infecting of man (animals are never infected) by the mosquito "carrier" of the filaria can be prevented by clearing away all the undergrowth round the masses of coconut palms, destroying the broken shells, thrown on one side in making the copra, which harbor water, and by destroying the rhinoceros beetle, which bores into the tree holes that retain moisture in which the mosquito breeds. The natives meanwhile will be carefully supplied with water from uncontaminated cisterns.

Elephantiasis is largely responsible for the apathy and lack of initiative on the part of the Polynesian, making necessary the introduction of Chinese and Indian labor for developing many natural resources. Filariasis also has a very serious effect on the birth rate. So far no drug is known which will destroy without killing the patient the hair-like worm (the males are 1½ inches long and the females 3 inches) which lives in the lymphatic glands.

The influenza epidemic of 1918 carried off nearly a third of the people of Samoa, tuberculosis is increasingly attacking men and women of marriageable age, and measles is usually fatal. All these problems are also to be studied by the expedition, as well as the dysentery epidemic which has been particularly bad this year. It is hoped to be able to arrange for the training of two or three native women in each village for infant welfare work. Especially important will be the researches into the effect of high atmospheric temperatures and moisture on the European. Dr. Buxton is also expected to make a study of the birds of

Samoa, and it is hoped he will be able to bring home to London a "didunculus," the first cousin to the extinct dodo, which still survives in one area. A careful selection of entomological specimens will also be made.

THE COLLEGE OF DENTISTRY OF THE UNIVERSITY OF CALIFORNIA

RECOGNITION of the work of the college of dentistry of the University of California is shown by the grant to it for three successive years, by the Research Commission of the American Dental Association, of funds for carrying on special investigations. For 1922–23, according to a statement made by Dr. Guy S. Millberry, dean of the College of Dentistry, the principal grant amounts to $2,000 and is awarded for research to be carried on by Dr. John A. Marshall, associate professor of biochemistry and dental pathology, in the influence of diet and nutrition on the development of the teeth. Dr. Marshall will also with the aid of this grant continue certain inquiries into the "salivary factor in dental decay" and into "dental erosion."

In addition, the research commission has made a grant of $1,500 to the university research group now carrying on experimental work in San Quentin Prison. This study is concerned with infections of the oral cavity. The investigators include Dr. Vance Simonton, associate professor of operative dentistry, Dr. W. Hanford and Dr. W. Fleming, instructors in preventive dentistry, Dr. C. O. Patten and Dr. C. Westbay, instructors in operative dentistry, for the College of Dentistry. Particularly concerned, also, in the chemical side of the research is Dr. Guy W. Clark, assistant professor of pharmacology, while similarly engaged on the bacteriological side are Associate Professors T. D. Beckwith and I. C. Hall.

The College of Dentistry will next January begin to use the income from a fund of $10,000 to meet the expense of an annual course of lectures, by noted authorities, on preventive dentistry. These lectures will at first be given in San Francisco, but as the fund increases through the efforts of the Alumni Association of the college they will be repeated in other centers of population. According to Dean Millberry the northern branch of the Dental Alumni Association is now committed to the raising of a quota of $5,000 to add to the $10,000 already in the hands of the Board of Regents.

THE MILBANK MEMORIAL FUND

IN the report of the Milbank Memorial Fund, established by the late Mrs. Elizabeth Milbank Anderson, recently issued, it is stated that $2,000,000 has been appropriated for health demonstrations in three typical communities with a population of half a million.

Under the plan announced the fund will attempt to demonstrate, by cooperation with agencies in these communities, whether the extent of sickness can be materially diminished by the intensive application of known health measures, and mortality rates further reduced; and whether these results can be achieved in a relatively short period of time and at a per capita cost which the communities will willingly bear.

"This project of the Milbank Memorial Fund, known as the New York Health and Tuberculosis Demonstrations, will be carried on in three localities in New York State typical of metropolitan, city and rural communities in the country at large. It will be conducted under the general supervision of a group of well-known leaders in public health and social work. Its purpose is to determine which diseases more readily yield to concerted attack, to what extent tuberculosis can be further reduced, whether the low infant mortality rate of 50 per 1,000 born attained in many progressive communities can be generally substituted for the rate of 100 or more still prevailing in parts of the United States; what preventive methods are most effective in controlling disease—in short, to ascertain what can be accomplished by the intensive application of public health measures in the fields of physical and mental, social and industrial hygiene. A record will be kept of the exact cost of each specific project and every effort made to keep the cost down to a minimum consistent with efficiency."

Actual work has been started in Cattaraugus county, with a population of about 72,000 and in the city of Syracuse, which has a population of about 175,000. The metropolitan district, though not yet definitely located, will probably be a section of New York City, with a population of about 200,000. The Board of Directors of the fund has set aside $325,000 annually for these projects.

The general supervision of the demonstrations will be in the hands of a technical board consisting of Dr. James Alexander Miller, of the College of Physicians and Surgeons; Dr. Linsly R. Williams, managing director of the National Tuberculosis Association; Dr. Livingston Farrand, president of Cornell University; Homer Folks, secretary of the State Charities Aid Association; Bailey B. Burritt, director of the New York Association for Improving the Condition of the Poor, and John A. Kingsbury, secretary of the fund.

ATTENDANCE AT SCIENTIFIC MEETINGS

THE following resolution was adopted by the Board of Managers of the Washington Academy of Sciences at a meeting held October 29, 1923:

Whereas, The work of scientific men has contributed enormously to the welfare of the human race and espe-

cially to the people of the United States of America, and

Whereas, The government of the United States has recognized the importance of scientific investigations and research by the creation of many scientific bureaus, and has appropriated large sums of money for carrying on their work which has been most beneficial to the health, industries and commerce of this country, and

Whereas, Our people should be kept informed promptly and fully of the progress made and results accomplished by the scientific organizations of the government, and

Whereas, The members of the government engaged on scientific activities can only function to the best advantage by having conferences with scientific men of this country not in government service and with such men of other countries, and

Whereas, This contact can only be gotten by attendance at scientific gatherings in this country and abroad; therefore, be it

Resolved, That the Washington Academy of Sciences hereby petition and urge the President, the heads of departments of the federal government, and the Congress of the United States to give the welfare of science in the United States their earnest consideration and assistance; and to provide by law and by appropriation of the necessary money for the attendance of such scientists of the government as heads of departments may designate at scientific congresses, conventions and meetings in this country; and for the attendance of such scientists of this country, both in the government and in private life, as may be recommended to the Department of State by competent authority and approved by the head of that department or the official acting for him, as representatives of the United States of America at international scientific congresses, conventions and meetings. These appropriations would be exceedingly small as compared with the returns from them in great benefits to scientific advance in America and hence to the promotion of the national welfare.

PRIZE OF THE AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE

To mark the seventy-fifth anniversary of the American Association for the Advancement of Science, a member of the association has given the sum of one thousand dollars to be awarded as a prize to the author of a paper containing a notable contribution to the advancement of science, presented at the Cincinnati meeting either before the association or before one of the affiliated societies. The award will be made by a committee to be appointed by the council of the association.

SCIENTIFIC NOTES AND NEWS

THE Nobel Prize for chemistry has been awarded to Professor Friedrich Pregl, of Graz. It will be remembered that the Nobel prize in physics has been awarded to Professor R. A. Millikan, and the prize in medicine to Professor J. J. R. Macleod and Dr. F. G. Banting.

SIR CHARLES SHERRINGTON, Waynflete professor of physiology at Oxford, has been nominated by the council of the Royal Society for reelection to the presidency. Awards of medals have been made as follows: Royal Medals to Sir Napier Shaw, F.R.S., for his researches in meteorological science, and to Professor C. J. Martin, F.R.S., for his researches on animal metabolism. The Copley Medal to Professor H. Lamb, F.R.S., for his researches in mathematical physics. The Davy Medal to Professor H. B. Baker, F.R.S., for his researches on the complete drying of gases and liquids. The Hughes Medal to Professor R. A. Millikan, of the California Institute of Technology, for his determination of the electronic charge and of other physical constants.

THE first award of the Thomas Turner gold medal was made on October 30 to Sir Robert Hadfield, Bart., in recognition of his distinguished contributions to metallurgy of steel. The medal is the outcome of a gift to perpetuate the memory of the work done by Professor Turner in the metallurgy of iron.

THE honorary fellowship of the American College of Surgeons was conferred upon Sir William Wheeler, president of the Royal College of Surgeons of Ireland, at the convocation ceremony in Chicago on October 26.

DR. ALEXANDER RUSSELL, principal of the Faraday House Electrical Engineering College, London, has been elected president of the British Institution of Electrical Engineers.

DR. A. LIPSCHUTZ, professor of physiology at Dorpat, has been elected to honorary membership in the Mexican Biological Society.

OFFICERS of the Cambridge Philosophical Society have been elected as follows: *President,* C. T. Heycock; *vice-presidents,* Professor A. C. Seward, Dr. H. Lamb, J. Barcroft; *treasurer,* F. A. Potts; *secretaries,* Professor H. F. Baker, F. W. Aston, J. Gray; *new members of the council,* F. P. White, E. V. Appleton, J. B. S. Haldane.

PROFESSOR LYMAN C. NEWELL, of Boston University, was delegate from the American Association for the Advancement of Science at the celebration of the fiftieth anniversary of Boston University, which occurred on October 25 and 26.

ARTHUR P. DAVIS, whose dismissal as director of the Reclamation Service by Secretary Work caused many protests from engineering and other bodies, has been elected to honorary membership by the Washington Society of Engineers. Mr. Davis is now in England, representing the Department of State on

engineering matters coming before the Pecuniary Claims Commission.

C. E. HALSTEAD, of the Research Laboratories of the Ward Baking Co., New York, is returning to Syracuse University after a two years' leave of absence.

THROUGH the courtesy of the Danish Government, the Academy of Natural Sciences, of Philadelphia, was enabled to send Samuel G. Gordon to southern Greenland for mineralogical research. Camps were established at Narsarsuk and the various localities on the Tunugdliarfik and Kangerdluarsuk Fiords. Mr. Gordon left England on the S. S. *Lom* on July 1 and returned to Philadelphia on November 11.

A DESPATCH from Berlin to the daily papers reports that Professor Albert Einstein, who left Germany largely because of outbursts of anti-Jewish sentiment, is residing in Leyden, The Netherlands, where he holds a chair of physics in the university and where he plans to stay until conditions in Germany improve sufficiently to allow of his return to Berlin.

DR. W. T. BOVIE, of the Harvard Medical School, gave a lecture before the Franklin Institute of Philadelphia on November 8 on "The electro-mechanics of cell growth."

SIR JAGADIS BOSE, director of the Bose Institute, Calcutta, will deliver a lecture at the Royal Society of Medicine, London, on "Assimilation and Circulation in Plants," on December 6. It will be illustrated on the epidiascope with the apparatus in operation.

DR. A. V. HILL'S inaugural lecture as Jodrell Professor of Physiology at University College, London, on "The present tendencies and the future compass of physiological science," will shortly be published by the University of London Press.

DR. ARTHUR L. DAY, director of the geophysical laboratory and chairman of the advisory committee in seismology, Carnegie Institution of Washington, gave an illustrated lecture before the institution on November 27, on "Cooperative earthquake studies in California."

AT the quarterly meeting of the Medico-Psychological Association of Great Britain and Ireland on November 22, Professor D. C. Winckler gave an address on the psychiatrical and neurological teaching at the Dutch universities, especially at the University of Utrecht, where he is the director of the psychiatric-neurological clinic.

THE Thomas Vicary Lecture before the Royal College of Surgeons of England will be delivered on December 7, by Sir Arthur Keith, F.R.S., the conservator. The lecture will be on the life and times of William Clift, first conservator.

A MEETING will be held at Clark University on the evening of December 7, in memory of Arthur Gordon Webster. President W. W. Atwood will preside, and Dr. A. P. Wills, of Columbia; Dr. Edwin H. Hall, of Harvard; Dr. M. I. Pupin, of Columbia, and Dr. G. Stanley Hall will speak.

JAMES SULLY, formerly professor of mind and logic at University College, London, known for his publications on psychology, died on November 2, at the age of eighty-one years.

EDMOND KNOWLES MUSPRATT, honorary president of the United Alkali Company and long associated with the English alkali and acid industry, a former pro-chancellor of the University of Liverpool, at which he endowed the laboratory of physical chemistry, has died at the age of ninety years.

DR. W. P. LATHAM, formerly Downing professor of medicine at the University of Cambridge, died on October 29, in his ninety-second year.

DR. T. H. GREEN, formerly physician to Charing Cross Hospital and author of a text-book of pathology well known to many generations of students, died on November 5, in his eighty-first year.

DR. JEAN PAUL LANGLOIS, professor of physiology in the University of Paris and editor of the *Revue Générale des Sciences*, died recently at the age of sixty-two years.

THE British Empire Exhibition at Wembley will include, as we learn from *Nature*, a pure chemistry exhibit, organized by a committee representing the relevant scientific societies, supported by the cooperation of the Royal Society. The following have agreed to organize the various sections of the chemical exhibit: Sir Ernest Rutherford (structure of the atom), Professor J. C. McLennan (spectroscopy), Sir Henry Miers (crystallography and crystal structure), Dr. A. Lapworth (valency theories and theories of chemical combination), Dr. T. Slater Price (photography), Professor F. G. Donnan (general physical chemistry), Dr. Alexander Scott (atomic weight determination), A. Chaston Chapman (analysis: hydrogen ion concentration), Professor E. C. C. Baly (general inorganic), Professor A. Smithells (flame, fuel and explosion waves), Dr. Henry and Prof. F. L. Pyman (organic chemistry), J. L. Baker (biochemistry), Sir John Russell (agricultural chemistry), Principal J. C. Irvine (sugars), Professor G. G. Henderson (terpenes), Professor I. M. Heilbron (plant coloring matters), Dr. J. T. Hewitt (coal-tar coloring matters), Professor J. F. Thorpe (general organic chem-

istry), C. F. Cross (cellulose), Dr. E. F. Armstrong (catalysis), W. F. Reid (explosives), Dr. W. R. Ormandy (plastics), Commander R. E. Stokes-Rees (apparatus), Professor J. W. Hinchley (chemical engineering), R. B. Pilcher (historical).

Students completing their work at Washington University for the doctorate of philosophy in the graduate laboratory in June, 1923, have been appointed to positions as follows: Dr. H. C. Young, chief in botany at the Ohio Experiment Station; Dr. A. F. Camp, plant pathologist to the Florida State Board of Agriculture and assigned to the Agricultural Experiment Station at Gainesville; Dr. L. J. Klotz, assistant professor in botany with special reference to physiology at the New Hampshire State College, and Dr. Grace E. Howard, curator of the botanical museum and instructor in botany, Wellesley College. Dr. S. G. Lehman has returned to his position as assistant plant pathologist at the North Carolina Agricultural Experiment Station, Raleigh, N. C.; Dr. F. S. Wolpert continues his work as instructor in science, Principia Academy, St. Louis; and Dr. Adele Lewis Grant has resumed her work as instructor in botany at Cornell University. Dr. Young formerly held the National Research Council (Crop Protection Institute) Fellowship for the investigation of the toxicity of sulphur; Drs. Camp, Klotz and Lehman were Rufus J. Lackland Research Fellows, and Miss Howard held a Jesse R. Barr Fellowship in Washington University. Upon the resignation of Dr. H. C. Young, Mr. L. E. Tisdale was appointed to the unexpired term of the National Research Council Fellowship, under the auspices of the Crop Protection Institute, to pursue further investigations on the use of sulphur as a fungicide.

Through the good offices of Professor T. D. A. Cockerell, of the University of Colorado, who has recently returned from a trip to the East, the Department of Agriculture has received an interesting collection of seeds of cereals, forage plants, vegetables and fruits from the Maritime Provincial Agricultural Bureau, Vladivostok. The collection contains more than 250 local varieties collected in Siberia. Since the climate of the section in which these seeds were obtained is quite similar to that of certain parts of the United States, it is believed that many of the varieties will prove of considerable value to the agriculturists of this country. The department has sent an assortment of cereals to the Maritime Agricultural Bureau in exchange for the seed supplied by them.

The establishment of a Sears-Roebuck agricultural research foundation to determine essential facts relating to the farming industry is announced by Julius Rosenwald, president of the Sears-Roebuck Company. He said the foundation will be headed by "the most capable men to be found in the agricultural research field." A field force also is contemplated. The announcement set out that every phase of agricultural economics will be studied.

A gift of $2,500 a year, for three years, for a research fellowship in connection with the newly organized Institute of Meat Packing at the University of Chicago has been made by Mr. Arthur Lowenstein, vice-president of Wilson and Company. This research will be carried on under Professor E. O. Jordan, chairman of the department of bacteriology of the university. Mr. Lowenstein is one of the special lecturers in the Institute of Meat Packing at the university as well as chairman of the committee on scientific research of the Institute of American Meat Packers.

The following resolutions were passed by the National Research Council at the meeting of the Interim Committee held on October 3:

"*Whereas,* An accurate knowledge of thermal effects connected with chemical processes is of the highest importance to the chemical and metallurgical industries, and whereas there does not exist in this country at the present time any bureau, laboratory or other organization devoted to investigations in this field; therefore, be it

"*Resolved,* That the National Research Council, acting upon the recommendation of the Division of Chemistry and Chemical Technology, direct the secretary to bring this matter to the attention of the director of the Bureau of Standards and urge him to create within the Bureau of Standards a laboratory which shall be devoted primarily to research in this field; and further, be it

"*Resolved,* That the National Research Council assist and support the director of the Bureau of Standards in any efforts which he may make in this direction."

We learn from *Nature* that at a meeting of the Linnean Society of New South Wales held on August 29, a proposal for the reservation of all areas in New South Wales with altitude greater than 4,000 feet was discussed, and it was resolved "that this society desires to advocate the reservation from alienation and the more conservative administration of the Crown Lands of New South Wales on which grow the upland forests at the sources of the principal rivers for the following considerations: (1) The quality and regularity of river supply, (2) the preservation of undergrowth and timber, and (3) the preservation of the fauna and flora of scientific value; and that the terms of this resolution be conveyed to the state government for consideration."

Age distribution of Prussia's population has recently been reported to the *Journal* of the American Medical Association, as follows: The number of children in the 0–15 age group, in 1910, amounted to

35 per cent. of the population. In 1920 this percentage had decreased to 29, in spite of the loss of men in the war. The number of men in the 20–50 age group was, in 1913, almost 8,500,000, but in 1920 only 7,700,000. The number of children in the 6–15 age group fell from 5,100,000 to 2,770,000. If this rate of decrease continues, five years from now, the percentage of children in the 0–15 age group will scarcely exceed 20, and will doubtless fall below 20 during the years following. On the contrary, as compared with 1917 and 1920, the mortality of children under 6 and of school children has risen for both sexes, and measurements of school children and of minors who have left school prove that there has been a downward trend of bodily health.

THE work which the Bureau of Standards is carrying out on a dictionary of specifications has made good progress. During the past month existing specifications have been collected from more than 75 per cent. of the important national technical societies, trade associations and governmental publishing agencies that have issued specifications. A fairly accurate estimate can now be made of the total number of available specifications for use in preparing the dictionary. Leaving out all duplications, it would appear that about 5,000 specifications are available from the above sources. However, not all of these specifications can properly be classed as related to commodities purchased by the federal, state and municipal governments and public institutions. It is believed that about 20,000 commodities do come within this class and of these more than 75 per cent. of all commodities purchased for government consumption are not covered by available specifications.

THE following resolution was passed at the recent St. Louis meeting of the American Fisheries Society:

WHEREAS, The attention of the American Fisheries Society has been drawn to the very important work on fish diseases and parasites now being conducted by the New York State Conservation Commission; and,

WHEREAS, This society recognizes that such work is fundamental to the future conduct and policy of fish culture; and,

WHEREAS, The rapid growth of population and increase of travel are placing a special drain on fish life; therefore, be it

Resolved, That this society commends especially this research work and expresses the hope that the State of New York, through legislative enactment and financial assistance, when necessary, will continue to carry on this work, which is recognized to be of great benefit to the entire country.

THE *Journal of Industrial and Engineering Chemistry* reports that the largest sale of pulp timber ever made by the United States Forest Service was announced recently. The transaction involves 334,000,000 cubic feet of timber in the Tongass National Forest, Alaska. The buyer, the firm of Hutton, McNear and Dougherty, of San Francisco, has agreed as part of the consideration for the timber to build a pulp manufacturing plant of not less than 100 tons daily capacity, and ultimately with a daily capacity of 200 tons, at the Cascade Creek water-power site on Thomas Bay, 20 miles from Petersburg, Alaska, within the Tongass National Forest. It is understood that the firm plans to install a complete newsprint plant with a daily capacity of 200 tons. According to the plans of the Forest Service for this sale unit, as well as for all pulp timber developments in Alaska, the timber will be cut on a perpetual supply basis, enough seed trees being left to insure complete natural reproduction. The volume of pulp timber and the area of timber-growing land within the unit, reserved from other disposition, are sufficient to afford a permanent source of raw material for this enterprise. Under the perpetual timber supply plan at least 1,500,000 tons of paper can ultimately be produced in Alaska every year. This amount is more than one half of the newsprint now consumed annually in the United States and nearly 20 per cent. of the total consumption of all kinds of paper and wood fiber products. As each new unit of timber and water power is developed in Alaska, the manufacturing capacity will be gauged to the timber supply and growing power of the land so that there will be no depletion of raw material. The Cascade Creek sale is in line with the policy for the development of the national forest in Alaska, which was a subject of special study by President Harding during his trip to the Territory and which received his endorsement.

WE regret that through an error made in the office of SCIENCE a letter from Henry B. Ward, of the University of Illinois, printed in the issue for November 9, was dated from the University of Nebraska.

UNIVERSITY AND EDUCATIONAL NOTES

THE *Journal* of the American Medical Association reports that the Johannesburg town council has given $100,000 to the University of Johannesburg Medical School, South Africa, and $25,000 to the Victoria Hospital. Bids have been received for the erection of the new medical school at Grotte Schuur, near Cape Town, South Africa, at an approximate cost of $500,000.

DR. ERNEST ANDERSON has resigned as head of the general chemistry division at the University of Nebraska to become head of the department of chemistry at the University of Arizona, Tucson.

Dr. V. H. Young, professor of botany and plant pathology in the University of Idaho, has been appointed to succeed the late Dr. J. A. Elliott as professor of plant pathology in the University of Arkansas and pathologist in the Agricultural Experiment Station.

Stewart A. Koser, of the U. S. Bureau of Chemistry, has been appointed assistant professor of bacteriology at the University of Illinois.

John L. Buys, of the University of Akron, has become professor of biology in St. Lawrence University, Canton, N. Y. A. L. Leathers, Ph.B. (Wesleyan '07), Ph.D. (Cornell '16), will teach zoology at Akron.

Carl Geister, of the chemistry section of the Iowa Engineering Experiment Station, has been appointed to the fellowship of the Vitrified Tile Floor Association at the Mellon Institute of Industrial Research.

Dr. John Ronald Currie, professor of preventive medicine, Queens University Faculty of Medicine, Kingston, Ont., has been appointed Henry Mechan professor of public health at the University of Glasgow, Scotland.

DISCUSSION AND CORRESPONDENCE

THE UNITY OF ENGLISH WEIGHTS

There is but one pound in the English system of weights, and that is the standard pound of 7,000 grains. Every weight known to the English system is a multiple of one or the other of these fundamental and invariable units. The multiples of the pound and of the grain which are used in trade have been fixed entirely by custom or convenience, and not by the prescriptions of arbitrary law. What has been established by custom may, of course, be abandoned by custom. That is the way with free men.

But Professor Alexander McAdie in his letter published in Science of August 24th, last, states: "7,000 grains make a pound, a certain kind of a pound; 5,760 make another kind of a pound."

The Troy pound (which is Mr. McAdie's another kind of a pound) was abolished as a legal weight in the United Kingdom eighty years ago, and the Troy pound is likewise entirely obsolete in the United States. There is accordingly only one pound weight in the United States and the United Kingdom.

The Troy ounce of 480 grains is now confined to use in the weighing of gold and silver bullion. Statistics of gold and silver production, for example, are given in millions of ounces. The Troy ounce, moreover, has been legally decimalized, both as to submultiples and multiples in the United Kingdom. The British statute on bullion weights provides for the division of the Troy ounce into tenths, hundredths and thousandths, and the Board of Trade standards include these decimal sub-multiples, and also standards for 1, 2, 3, 4, 5, 10, 20, 30, 40, 50, 100, 200, 300, 400 and 500 ounce weights of the Troy or bullion ounce. These decimal sub-multiples and multiples of the Troy ounce are in fact the only Troy weights offered to the trade in England or America. In the Assay Office in New York, gold bullion is weighed in the balance against 500 ounce Troy weights, and the intermediate decimal multiple weights are available when required.

The Troy ounce is obsolete as an apothecary's measure. It is the grain (and there is only one grain in the English system) which is the English unit for medical prescription. The ounce of the apothecaries is not the Troy ounce, but the ounce measure or fluid ounce, which in England is the volume of the standard ounce of water, and in America is the sixteenth part of the pint of the old wine gallon of 231 cubic inches. There is some variation here, the American fluid ounce being the volume of 1.042 ounces of water, whereas the British fluid ounce is the volume of an ounce (one sixteenth of a pound) of water, precisely. We ought to adopt the British fluid ounce in this country. Even now it is customary for apothecaries to regard the fluid ounce as the measure of an ounce of water flat.

Drugs and fine chemicals are fast becoming handled in the trade as "ounce goods," and as such are quoted and sold by the hundred or thousand ounces, the British standard or avoirdupois ounce being indicated, and such drugs, purchased by the avoirdupois ounce, are dispensed on prescription by grains weight, when not sold in solutions measured in fluid ounces. The foregoing is in conformity not only to present practice, but also to the recommendations made by the commissioners for the Restoration of the Standards, in their report to Parliament of December 21, 1841, from which the following paragraphs are quoted:

41. That the Troy pound be no longer recognized; that the word pound, or any letters or symbols commonly used to denote the pound, as applied to a weight, be always interpreted to mean the pound of 7,000 grains (formerly called the avoirdupois pound).

42. That the word ounce be always interpreted to mean 1/16th part of the pound, except it be described as the Troy ounce.

43. That the use of the Troy ounce and pennyweight be confined to gold, silver and precious stones.

44. That in contracts applying to any other substance whatever (drugs included) no denomination be recognized lower than the pound except the ounce, the grain and the decimal parts of the pound.

The movement to decimalize the standard ounce, just as the Troy ounce for bullion weights has been

decimalized, ought to be encouraged. Weights of the tenth, hundredth and thousandth part of the standard ounce are now available to the trade, and fine balances with beams graduated to tenths and hundredths of the ounce, are also offered by manufacturers. Package goods for retail trade ought to come in 10, 20, 30, 40, 50 or 100 ounce containers, and liquids should come in containers of the same denominations of fluid ounces, the fluid ounce being newly defined as the volume of the standard ounce of water.

And there is an advantage of far-reaching importance in this project. The inch, equal to 25.4 millimeters, which is the most precise as well as practicable value which can be given the inch, produces 304.8 mm to the foot; or 30.48 mm to the tenth of the foot, the cube of which is 28,316.877072 cubic millimeters, from which it follows that the weight of the cube of the tenth of the foot of water is 28,316.877072 milligrams. But the kilogram, while projected as the weight of the liter of water, has been found to be the weight of 1.000,027 liters of water, which means that the liter of water weighs 1,000,000/1,000,027 kilograms, and that the cc of water weighs 1,000,000/1,000,027 grams. Applying the correction, we find that the cube of the tenth of a foot of water weighs 28,316.112536 milligrams. As the standard ounce is 28,350.2 milligrams in weight, the weight of the cube of the tenth of the foot of water is but 34.1 milligrams less than the weight of the standard ounce. The weight of the grain is 64.8 milligrams, so that by reducing the standard ounce 341/648 or .526 of a grain, or from 437.5 grains to 436.974 grains, we can produce a new ounce which is precisely equal to the weight of the cube of the tenth of the foot of water, and of which 1,000 would equal one cubic foot, just as 1,000 grams equal 1 cubic decimeter of water.

Let us, therefore, have a new American standard ounce, precisely equal in weight to the ounce measure of water, defined as the volume of the cube of the tenth of the foot, and then let the standard American ounce be divided into decimal sub-multiples corresponding to the dimes, cents and mills of the dollar, and be used in decimal multiples for retail trade weights. The change from our present weight standards would only be about one per thousand (or more precisely, 1 per 900), which is well within the tolerances allowed for trade weights. The change would accordingly be entirely negligible in trade and contracts, and would give us a scientific precision in weights, and a correlation of weights and volumes that leaves nothing to be desired.

The so-called long ton in America should be abolished by law, as it has already become obsolete by custom in a large part of the country. The long ton is now unknown in the great coal and metalliferous mining trades of the Rocky Mountain region. The all-important ton-mile of the railroads, in universal use the country over, is based on the standard ton of 2,000 pounds.

The Troy pound may be regarded as obsolete, and the long ton as obsolescent, and accordingly as non-existent in the United States, except in the historical sense.

SAM'L RUSSELL

WASHINGTON, D. C.

PECULIAR HAIL

WHILE engaged in field work for the Illinois Geological Survey in the vicinity of Oregon, Illinois, the writer observed a hail storm that had certain peculiar characteristics. The storm occurred about mid-afternoon on August 7, and was observed in Oregon, which is in Rock River Valley, about 100 miles west of Chicago.

The preliminary meteorological conditions were: (1) A gentle two-hours' rain in the early forenoon, followed by clear skies; (2) increasing cloudiness towards noon with heavy storm clouds formed in the northwest, from which a hard rain passed to the south and another to the north and east; (3) increasing sultriness after noon until it became very oppressive prior to the close approach of the storm, and (4) an apparently heavy rain moving from northwest to the north and east, followed by the formation or splitting off of a smaller storm in the northwest, which spread rapidly west and south as it moved southeastward toward Oregon. In the latter storm heavy, dark clouds were moving swiftly, with considerable "boiling" in the southeast portion. High wind and heavy rain appeared to be approaching rapidly, accompanied by some violent lightning and thunder, but less than is common in a typical thunderstorm.

The storm reached Oregon from the northwest as a sudden squall of wind, quickly followed by large raindrops, with a few hail of uncommon size. Leaves began to be abundantly blown and beaten off the trees. The hail increased rapidly in size and quantity so that the lawns were soon covered as though by a layer of coarse quartz gravel. This continued for about three minutes, with considerable wind and rain, then the storm rather rapidly subsided, until the sun was shining about 15 minutes after the first hail fell. In one district only was the wind violent, as evidenced by overturned trees and shattered windows. Outside of this limited area few windows were broken.

Most of the hail was of a size and form not observed hitherto by the writer in his experience with hail storms in the Mississippi Valley and the northern Rocky Mountains. Hail measured immediately at the close of the storm with dimensions of 2″ x 1″ x ¾″ were plentiful, and a few were 2½″ x 2″ x 1¼″. One stone 2″ x 3″ was reported. Hail about one inch

across was the dominant size, with apparently few less than one half inch in diameter.

Much of the hail was of peculiar form as well as of uncommon size. The smaller stones were spherical to subspherical, and had a frosted appearance. Some were markedly discoidal with a frosted nucleus surrounded by relatively clear ice. This nucleus exhibited clearly in many specimens concentric layers of clear and frosted ice surrounding a more or less frosted core. This type of hail attained a maximum diameter of one inch or slightly more. The larger stones had a different form, characterized by fantastic outlines and unequal diameters. Many had the appearance of a mass of small pieces of hard candy that had stuck firmly together. Others resembled a group of blunt crystals studding a portion of the wall of a geode. Still others consisted of an irregular solid mass with more or less cylindrical, bluntly spinose projections up to one half inch long and one eighth inch thick.

These bizarre large hail appeared to have resulted from several small stones becoming frozen together during their formation and descent, with the interstices perhaps filled with added ice. The rounded outlines of some of the individual stones could be observed, and were brought into relief through melting. The spinose projections on the masses of aggregated stones are inexplicable by the writer, for they showed no trace of a composite nature, but appeared to have formed as distinct homogeneous projections.

ARTHUR BEVAN
DEPARTMENT OF GEOLOGY,
UNIVERSITY OF ILLINOIS

THE NEW YORK STATE FORESTS

IN SCIENCE for November 2, 1923, resolutions passed by the executive board of the American Engineering Council advocating abolishing the constitutional protection of the New York state forests were printed.

The citizens of that state have invariably voted down that proposal in whatever form it has been presented, and recently they did so again by a decisive majority. This is not because any intelligent person is opposed to scientific forestry or the proper use of the power resources of that region. It is because there exists no machinery in the state government to insure the continued application of any system of real forestry to those lands if they are opened up to commercial exploitation, and because the laws and the constitution do not appear to provide any safe and reliable means for establishing any. The forests would be in charge of officials whose term of service would be likely to end after the next election, and if a good administration saved any of the forest, it would only be for the bad one following to make away with.

That until the problem of the continued proper administration of those forests is solved, any breaking down of their present constitutional protection means their destruction is a fact so self-evident as to require no discussion. The resolutions ignore this completely.

People familiar with the Adirondack and Catskill regions will be curious to learn where the "great volume of ripened timber" that is stated to be decaying away is located.

The increasing practice of securing the indorsement of prominent scientific and professional organizations for schemes and proposals without the members having knowledge or understanding of the things they are represented as approving is an evil that can not fail to affect adversely not only the organizations, but the public's respect for scientific opinion.

WILLARD G. VAN NAME
NEW YORK CITY

THE PROFESSOR AND HIS WAGES

WHILE in other circumstances I might hesitate to trespass on your columns to the exclusion of more important matter than controversy, self-defense is an excuse which makes even trespass lawful. It is a pity that Mr. Welsh read my letter with so little attention before he started to answer it, and rebuke me for "theorizing without that judgment and knowledge of 'how much' that only experience in the field dealt with teaches."

Item, he accuses me of overestimating the rewards of the business man in my little table of comparison with the professor: "The profits assumed for the merchant are much beyond the average." Quite so! If Mr. Welsh will reread my letter he will find the words "Admitting that not all merchants are as successful as Mr. Smith . . ." I specifically stated that I was comparing two unusually successful and competent men, one in business, the other in teaching. If Mr. Welsh supposes that the *average* college professor gets $4,000 a year, or that the average teacher ever obtains a professorship in any large institution, he will find little confirmation in the various studies of university, college and secondary school conditions made by the Rockefeller and Carnegie Foundations.

Item, he accuses me of dismissing "quite lightly" the risk of capital in business, a point on which I laid particular stress: "The rewards of the entrepreneur are and should be higher than those of the salaried man because his risks are greater. . . ."

Item, Mr. Welsh justifies the higher incomes of businessmen on the ground that they are a selected class and the "average professor should not be compared with the successful businessman but rather with the latter's employees." Which reminds me strongly of my own statement that "we need not assume that the average instructor or professor is as

able as a captain of finance." The ablest professors in the country would be overjoyed to have a salary equal to that of the higher and more competent business employees, the factory managers, expert salesmen, etc. But by "employees" Mr. Welsh seems to mean "clerks," for in his final sentence he ranks the merit of the average professor below that of the average clerk. That would put the young instructors and the secondary school teachers level with the office boy, and as for the primary teachers would not a German mark be overpayment?

But grant everything Mr. Welsh says. Suppose that the great majority of our faculties are made up of "unselected" weaklings or incompetents who "get all they are worth to the community." The real point remains. Is Mr. Welsh content that such men, cheap men bought for an unskilled laborer's wages, should instruct *his* children? Or is he willing to raise the price and get better men? Or does he consider science and scholarship so unimportant that they can be confidently entrusted to an inferior type of human being?

PRESTON SLOSSON

ANN ARBOR, MICHIGAN

A WARNING TO MICROSCOPE USERS

FROM personal experience the writer wishes to warn both the microscope user and manufacturer of the danger of the projecting corrugated rim of the ordinary microscopical eyepiece as an agent for producing an epithelioma in the region of the orbit. This applies especially to the binocular microscope, where it is almost impossible to look through the microscope without scraping a piece of nasal epithelium with the eyepiece. Can any other procedure, if repeated day after day for year after year, be any more favorable for the production of an epithelioma on the side of the nose?

WM. F. ALLEN

UNIVERSITY OF OREGON MEDICAL SCHOOL

SCIENTIFIC BOOKS

Mankind at the Crossroads. By E. M. EAST. 8vo., viii + 360 pp. New York, Scribners, 1923.

WE have here a book on "Population" by a biologist. It is devoted to the discussion, in a general way, of the quantity and quality aspects of the population problem.

The argument of the book is to the effect that: (1) Certain processes in present-day civilization are dysgenic due to the fact that it is made easy for inferior types to breed more rapidly than superior types; (2) the present rate of increase of the white race will bring it up against food barriers in about fifty years; (3) many parts of the world—particularly those inhabited by the brown and yellow races—are already so filled that but little further increase can take place; (4) the sensible thing for us to do in the light of these facts is to undertake a thoroughgoing control of population growth, both for the purpose of preventing deterioration in the quality of the stock, and in order to keep numbers down to the point where man may have time and energy for something besides extracting a meager living from the soil.

After a short introductory chapter calling attention to the urgency of population problems, Professor East opens his argument proper by exposition of the biological principles which must be kept in mind in any discussion of population. It is interesting to note that he—a genetic specialist—is far less dogmatic on the question of the inheritance of acquired character than most biologists. "Everything is relative," says the author, and with that belief one can not very well be dogmatic on such a matter. "For all practical purposes," however, the possibility of the inheritance of acquired characters can be disregarded.

His statement of the way in which racial traits have probably developed and the likely results of race crossings is of fundamental importance to the social scientist; while the explanation of the significance of the mechanism of heredity is of great interest and importance to everyone. These facts of heredity urge more potently than any emotional appeal, care in selection of mates. And yet one is not made to feel that breeding superior stock is the sole aim of life, as many eugenists seem to think. After showing that we now have sufficient biological knowledge to enable us to maintain our stock at its present level of ability or, even to improve it, the author wonders whether we have the ability to apply this knowledge.

The rest of the book may be looked upon as an effort (very successful in the reviewer's judgment) to prove that we must undertake in a definite manner to control population growth in the light of clearly established biological principles, and in the light of our knowledge regarding the food supply, if we are not come to grief in the near future. A brief review of population opinions held in the past is followed by a statement of the growth of population in the world to-day, and what this means in terms of increased production of food. The author comes to the conclusion that three times the present population of the world will use up all tillable land, and that when there is this population, the standard of living will be about the equivalent of that of the peasants of western Europe. At our present rate of increase, it will take about a century for population to triple. But, Professor East shows that within about fifty years that part of the world open to Europeans will be so filled up, at present rates of increase, that pressure will become keen and the positive checks—famine, disease, war—will become operative. The chapters on

"Population and Food Supply" and "Permanent Agriculture, Population Restriction and National Progress' will give pause to those optimists, who are so, because they ignore facts. Professor East has done notable service in bringing the pertinent facts together in such concise fashion, and in driving them home with all the force of a very clear style. It is true he asks us to take some of his facts on faith, but the tone of his whole discussion rings true, and those of us who have given some attention to the study of the same matters know that his facts are facts, not guesses or surmises.

The chapter on "Racial Prospects and Racial Dangers" effectually disposes of such inaccurate vaporings as those of Lothrop Stoddard in his "Rising Tide of Color." Here, too, he makes concrete application of what genetics has to teach about race mixtures. His discussion of the race problem in the United States is scarcely convincing, but it deserves attention.

The chapter on the "Rôle of Death in the Drama of Life" seems rather superfluous. Such matter as is germane to the general argument could have been discussed under Public Health. The chapters on Birth Restriction and Public Health and The Birth Rate and Social Progress, drive home the truth that only by properly controlled population growth can we hope to make any real progress in social improvement. Without restriction of birth, we will soon be so driven by pressure upon the limited means of subsistence that no forward movement will be possible, and unless this restriction is directed intelligently, the quality of the people is sure to decline. One may feel less certain of the value of the methods now available for picking out the better stock than Professor East does (mental tests in general, and Army tests in particular) and yet agree with his general conclusion regarding the necessity for intelligent selection.

One is also glad to note that he does not assume that modern medicine and charity have entirely eliminated natural selection from the social process as so many biologists, perhaps one should say eugenists, seem to hold. Selection among men has always had an artificial (social) element in it and this element is not greatly changed in intensity to-day from what it was two or three centuries ago.

Other good points are the recognition of the vital rôle of social influences in individual and group development; the realization that there can never be a sound eugenics so long as the rapid breeding of better stocks to replace poor stocks is its sole aim; the emphasis upon the fact that there is much good ability in all classes of the population; the strong faith in the ability of man to control his own destiny; the consequent belief in the efficacy of education; and the conviction that a high type of family life lies at the root of any sound social order.

It is impossible, however, to do justice to the general excellence of this book by trying to give a notion of its contents. It is easily the best book on the practical aspects of our quantity and quality population problems that has appeared in America. It is written in a clear forceful style which proves that science need not be dry as dust to be truthful. It represents the gathering together of an enormous mass of facts, and such a complete assimilation of these facts that the conclusions may seem too little based on evidence to one unfamiliar with this field. A less thorough assimilation and a less skillful presentation would, however, only have wearied the reader with details, without carrying as much conviction.

It is a book no one interested in social problems can ignore.

WARREN S. THOMPSON

MIAMI UNIVERSITY

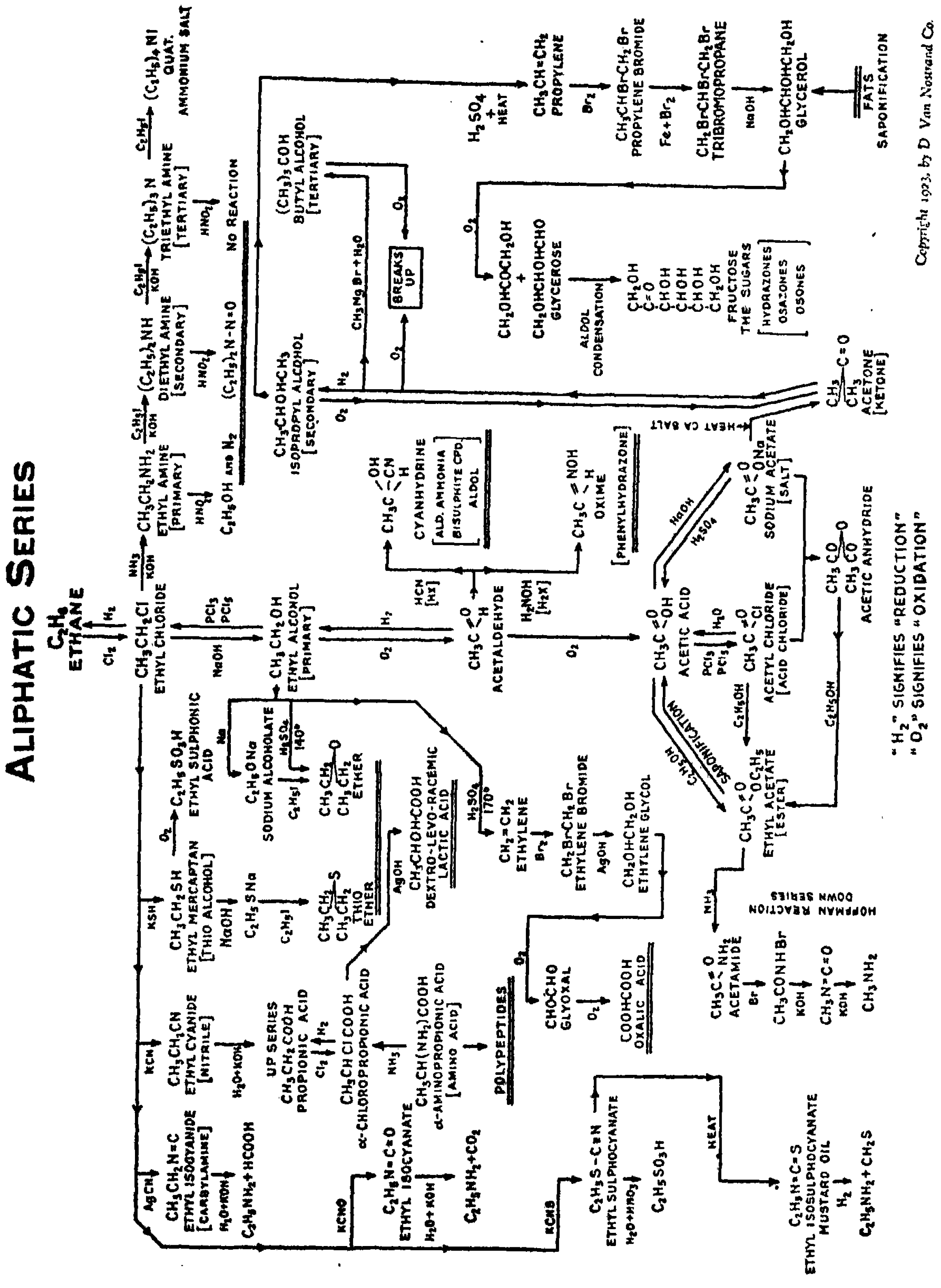
ORGANIC CHEMICAL TRANSFORMATIONS

IT is the belief of the writers that the most important thing in the teaching of organic chemistry is to make the student understand the fundamental relations existing between the different classes of organic compounds. To this should be added a knowledge of the typical reactions which these compounds undergo. Only when he has attained this point of view does he begin to see the truly remarkable order which in reality prevails among the mass of material which is presented to him; and only when he appreciates this order will he make good progress in the subject.

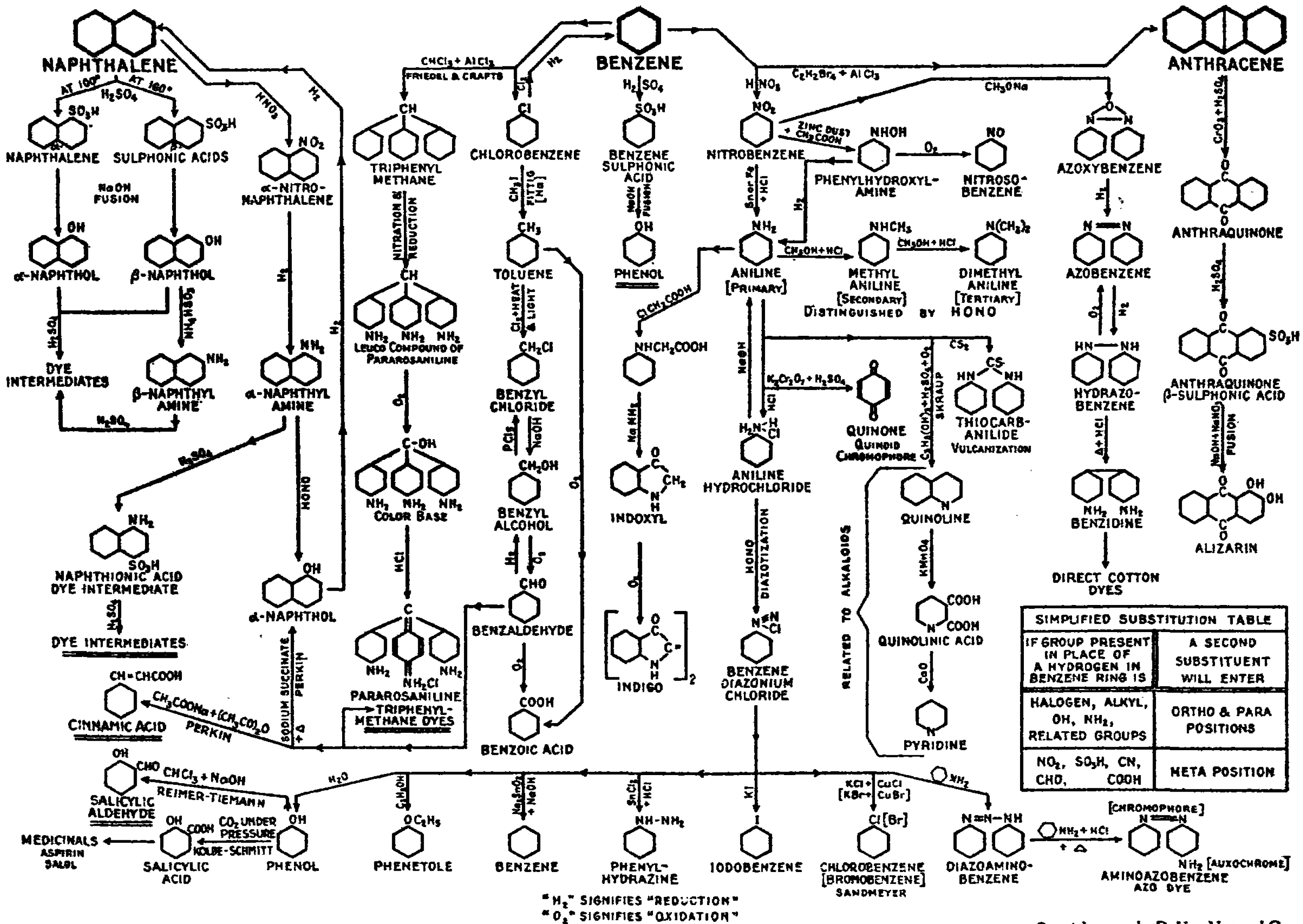
As a result, the charts which accompany this introduction were elaborated, with the aim of presenting these fundamental relations and typical reactions in as concrete a form and as small a space as possible.

In the first or aliphatic series chart, the starting point is the basic hydrocarbon ethane, and from this it is possible to pass to every other compound indicated, by following the arrows. The reagent required to effect each change appears upon the arrow showing that change. Ethane was chosen as the starting point because its derivatives are relatively simple. Methane is not suitable, because the reactions of its derivatives present too many exceptions to the general rules holding for those of its higher homologues. The chart includes methods for passing up and down the series, and references to optical activity, amino acids and sugars.

In the aromatic series chart, the basic hydrocarbon is, of course, benzene, supplemented by naphthalene and anthracene. It is possible to pass from benzene to every other compound shown on the chart. In this series the vast number of important derivatives present a real difficulty, which has been obviated in part


ALIPHATIC SERIES
C_2H_6 ETHANE
CH_3CH_2Cl ETHYL CHLORIDE
CH_3CH_2OH ETHYL ALCOHOL [PRIMARY]
$CH_3C\langle{}^{O}_{H}$ ACETALDEHYDE
$CH_3C\langle{}^{O}_{OH}$ ACETIC ACID
$CH_3CH_2NH_2$ ETHYL AMINE [PRIMARY]
$(C_2H_5)_2NH$ DIETHYL AMINE [SECONDARY]
$(C_2H_5)_3N$ TRIETHYL AMINE [TERTIARY]
$(C_2H_5)_4NI$ QUAT. AMMONIUM SALT
NO REACTION
$CH_3CHOHCH_3$ ISOPROPYL ALCOHOL [SECONDARY]
$(CH_3)_3COH$ BUTYL ALCOHOL [TERTIARY]
BREAKS UP
$CH_3CH{=}CH_2$ PROPYLENE
$CH_3CHBrCH_2Br$ PROPYLENE BROMIDE
$CH_2BrCHBrCH_2Br$ TRIBROMOPROPANE
$CH_2OHCHOHCH_2OH$ GLYCEROL
FATS SAPONIFICATION
$CH_2OHCOCH_2OH$ + $CH_2OHCHOHCHO$ GLYCEROSE
ALDOL CONDENSATION
FRUCTOSE THE SUGARS
HYDRAZONES OSAZONES OSONES
CYANHYDRINE
ALD. AMMONIA BISULPHITE CPD ALDOL
OXIME
[PHENYLHYDRAZONE]
$CH_3C\langle{}^{O}_{ONa}$ SODIUM ACETATE [SALT]
$CH_3-C{=}O$ CH_3 ACETONE [KETONE]
HEAT CA SALT
$CH_3C\langle{}^{O}_{Cl}$ ACETYL CHLORIDE [ACID CHLORIDE]
ACETIC ANHYDRIDE
$CH_3C\langle{}^{O}_{OC_2H_5}$ ETHYL ACETATE [ESTER]
SAPONIFICATION
$CH_3C\langle{}^{O}_{NH_2}$ ACETAMIDE
$CH_3CONHBr$
$CH_3N{=}C{=}O$
CH_3NH_2
HOFFMAN REACTION DOWN SERIES
$C_2H_5SO_3H$ ETHYL SULPHONIC ACID
C_2H_5ONa SODIUM ALCOHOLATE
$CH_3CH_2-O-CH_2CH_3$ ETHER
$CH_2{=}CH_2$ ETHYLENE
CH_2BrCH_2Br ETHYLENE BROMIDE
CH_2OHCH_2OH ETHYLENE GLYCOL
$CH_3CHOHCOOH$ DEXTRO-LEVO-RACEMIC LACTIC ACID
CH_3CH_2SH ETHYL MERCAPTAN [THIO ALCOHOL]
C_2H_5SNa
THIO ETHER
CHO-CHO GLYOXAL
COOH-COOH OXALIC ACID
CH_3CH_2CN ETHYL CYANIDE [NITRILE]
UP SERIES CH_3CH_2COOH PROPIONIC ACID
$CH_3CHClCOOH$ α-CHLOROPROPIONIC ACID
$CH_3CH(NH_2)COOH$ α-AMINOPROPIONIC ACID [AMINO ACID]
POLYPEPTIDES
$CH_3CH_2N{=}C$ ETHYL ISOCYANIDE [CARBYLAMINE]
$C_2H_5NH_2$ + HCOOH
$C_2H_5N{=}C{=}O$ ETHYL ISOCYANATE
$C_2H_5NH_2$ + CO_2
$C_2H_5S-C{\equiv}N$ ETHYL SULPHOCYANATE
$C_2H_5SO_3H$
$C_2H_5N{=}C{=}S$ ETHYL ISOSULPHOCYANATE MUSTARD OIL
$C_2H_5NH_2$ + CH_2S
"H_2" SIGNIFIES "REDUCTION"
"O_2" SIGNIFIES "OXIDATION"
Copyright 1923, by D Van Nostrand Co.

AROMATIC SERIES



SIMPLIFIED SUBSTITUTION TABLE	
IF GROUP PRESENT IN PLACE OF A HYDROGEN IN BENZENE RING IS	A SECOND SUBSTITUENT WILL ENTER
HALOGEN, ALKYL, OH, NH_2, RELATED GROUPS	ORTHO & PARA POSITIONS
NO_2, SO_3H, CN, CHO, COOH	META POSITION

by presenting, essentially, only the monosubstitution products of benzene. Reference is made to several types of dyes, including the azo, benzidine, triphenyl methane, indigo, alizarin and naphthalene varieties. Reference is also made to certain medicinals, and to pyridine and quinoline, as related to the alkaloids. A simplified substitution table is included.

It is hoped that the charts may be of a certain service to the teacher as an aid to the presentation of his subject; and as a help to the student to fully appreciate that presentation. It is further designed to aid the student in reviewing his work, and in comprehending it as a whole, as well as in its component parts.

Realizing that it is virtually impossible to include all compounds or all reactions which are of importance, in a classification such as they are presenting, the writers will appreciate any constructive criticism from teachers of organic chemistry, by means of which the charts may be made more useful.

These may be obtained in any quantity, in a folder including both, from D. Van Nostrand & Company, New York.

LUCIUS A. BIGELOW
KURWIN R. BOYES

BROWN UNIVERSITY

SPECIAL ARTICLES

A SATISFACTORY RATION FOR STOCK RATS

As long as actual feeding trials must serve as the means for determining the nutritive sufficiency of rations, laboratory animals such as the rat, rabbit, dog and guinea pig will always be used in large numbers for this work as well as for cultural work in bacteriology, for pathology, immunology and kindred sciences. For this reason anything which can be done to facilitate the breeding and maintenance of these animals in sufficient numbers and in excellent condition will often free the laboratory worker from much uncertainty with respect to maintaining the continuity of his researches.

The writer has been especially impressed with the desire for information in regard to rat culture as brought out by the numerous inquiries received in the last five years *for a ration formula satisfactory for rats.* From the character of much of the experimental work reported from different laboratories it also is evident that many of the rat-feeding experiments are now being carried out on rats not entirely suitable for the various problems under investigation. This is true by virtue of the fact that most young rats are undersized, due to limited milk production of the mother causing them to not only partially starve but also to eat excessively of the mother's ration before their time. The rations on which they are kept are often too low in good proteins, too low in calcium, sodium or chlorine or too low in the fat-soluble vitamines. The trouble may not always be on the deficiency side, however; the ration may contain too much indigestible material, too much protein, and sometimes even too much fat-soluble vitamines, the latter not inhibiting growth but causing excessive storage which is very disturbing in experiments designed to test for these constituents.

In spite of the need for a good economical rat ration practically nothing appears in the literature to meet the situation. In view of this the writer sees fit to publish the composition of his stock ration, which, finely ground and fed with fresh whole milk and water in separate containers ad libitum, has given him excellent results for a number of years. It is constituted as follows:

Yellow corn	76.0
Linseed oil meal	16.0
Crude casein	5.0
Ground alfalfa	2.0
Sodium chloride	.5
Calcium carbonate	.5

From the theoretical standpoint it would be best to have different rations for growth, for reproduction and lactation and for maintenance, but that is a refinement which probably is not practical under most laboratory conditions, as most of the animals are either growing, reproducing, lactating or recuperating from the strain of the latter, all of which conditions require a ration with a narrow nutritive ratio. As to whether or not the requirements are satisfactorily met is best indicated by the ability of the mother to withstand the strain of reproduction repeatedly and by the growth of the young. With this we have had absolutely no trouble. The females are kept for breeding purposes for a year with no signs of premature senility, and the young average in at least 90 per cent. of the litters 40 to 55 grams in weight at an age of 23 days; in fact, when they weigh less at this age we discard them as unsuitable for experimental work.

When milk is omitted from the ration the results are not as satisfactory. This is due to a number of factors. In the first place, the content of available fat-soluble vitamines is not sufficient. This we have remedied by the addition of one to two per cent. of cod liver oil, but it leaves the ration less satisfactory when the rats of the colony are to be used for work on these vitamines. In the second place, the calcium content is too low; in fact, even with milk included in the ration, the calcium is not too high for optimum results. We have purposely kept the calcium added as carbonate low because it is apparently not the best salt to use in

large amounts, probably due to neutralization of gastric contents; we have, however, obtained very good results with one per cent. of precipitated calcium phosphate or 1.5 per cent. of bone ash, but our experience with these, in view of the good results obtained with the ration as outlined, are not sufficiently extensive to warrant the change when milk is fed. In the third place, the protein content could probably be advantageously increased.

As milk is available in sufficient quantities at all times in the writer's laboratory, no extensive or prolonged experience with a milk-free ration comparable in efficiency to a milk-containing ration can be drawn upon. When available, fresh whole milk produced by cows on a non-varying ration should be used as a constant ingredient of the stock colony ration, as it serves to cover most effiicently not only known requirements, but no doubt many requirements not as yet appreciated. The factor of proper nutritive condition of the young rats before being started on their various dietary regimens is a factor which enters into the results of all experiments and therefore is worthy of far greater attention than it is given in most laboratories.

H. STEENBOCK
LABORATORY OF AGRICULTURAL CHEMISTRY,
UNIVERSITY OF WISCONSIN

ALKALOIDAL CONTENT OF DATURAS AFFECTED BY MOSAIC INJURY

PLANTS of *Datura Stramonium* grown in the drug garden maintained by the Department of Pharmacognosy of Western Reserve University during the season of 1922 were severely injured by mosaic. The injury affected both green-stemmed and purple-stemmed plants, both being, apparently, equally susceptible. The symptoms of the disease appeared during the height of the growing season, being manifested in the developing leaves, which remained small, and became mottled and distorted. The width of the affected leaves was much reduced, while the tips and the extremities of the dentations were more nearly of normal length, giving the leaves the characteristic stringy appearance not uncommon in mosaic troubles. The plants as a whole were below normal in development.

As the drug value of these Daturas, both of which are official as "Stramonium" in the United States Pharmacopoeia, is believed to depend on their alkaloidal content, alkaloidal analyses were made of both diseased leaves and leaves from plants which showed no mosaic. Leaves taken for analyses were handpicked from closely adjoining plants at the same time. The petioles were removed. The leaves were dried simultaneously, as rapidly as possible, on the same shelf of a hot-air oven at a temperature not over 100°. Analyses were made by the official method of the United States Pharmacopoeia IX. The results are tabulated below.

TABLE I

					Per cent. alkaloids	Average
Purple-stemmed	plants,	mosaic,	Sample	1...	0.27	
"	"	"	"	2...	0.28	0.275
"	"	normal	"	1...	0.147	
"	"	"	"	2...	0.138	0.142
Green-stemmed	plants,	mosaic,	Sample	1...	0.27	
"	"	"	"	2...	0.303	0.285
"	"	normal	"	1...	0.072	
"	"	"	"	2...	0.072	0.072

It will be noted that the figures for mosaic plants of both varieties are slightly above the official alkaloidal requirements (0.25 per cent.) for Stramonium as a drug, and, by themselves, are therefore by no means remarkable. The notably low results of the normal leaves may be considered as rather unusual, especially in the case of the green-stemmed plants, inasmuch as both varieties appear rarely to fall below the pharmacopoeial requirement. The locality of growth was considerably shaded. Schneider[1] has observed that plants of the closely related *Atropa belladonna* show a markedly higher alkaloidal yield when grown in full sun. Inasmuch as the Daturas are normally sun-loving plants, it appears not improbable that the factor of insolation may have been involved. As the mosaic plants were subjected to the same conditions, this factor can not be held responsible for the marked disparity in content between normal and mosaic leaves. Sievers[2] has shown a marked increase of alkaloidal content following prevention of flowering in the Daturas; while flowering was by no means inhibited in these mosaic plants, it was apparently hindered to some extent by the distortion of the flowering-tops. In Sievers's experiments, however, inhibition of flowering increased the size of leaves—the converse of the effect of mosaic. The same author[3] has also shown an increased concentration of the alkaloidal content of belladonna in the tender growing parts, which, in the Daturas, are most affected by mosaic. It is evident, of course, that a given weight of mosaic material represents a considerably greater number of leaves than the same weight of normal leaves.

[1] Schneider, Albert, "The cultivation of belladonna in California," Bulletin 275, Agricultural Experiment Station, Berkeley, Cal., 1916.

[2] Sievers, A. F., "The influence of inhibiting flowering on the formation of alkaloids in the Daturas," *Jour.* of the American Pharmaceutical Association, Vol. X, No. 9, pp. 674–676, 1921.

[3] Sievers, A. F., "The distribution of alkaloids in the belladonna plant," *Am. Journ. Pharm.*, Vol. 86, No. 2, p. 97, 1914.

It is planned to continue the observation of the symptoms and effects of mosaics on the Daturas, with special reference to alkaloidal yield. Inasmuch as a somewhat similar disease has been noted here on *Hyoscyamus niger*, this species also will be subjected to similar investigations if the disease reappears.

E. E. STANFORD
E. D. DAVY
WESTERN RESERVE UNIVERSITY

THE OPTICAL SOCIETY OF AMERICA

THE eighth annual meeting of the Optical Society of America, Dr. L. T. Troland, president, was held at Cleveland, Ohio, Thursday, Friday and Saturday, October 25–27, 1923. Hotel headquarters were at the Hotel Cleveland. All sessions for the reading of papers were held in the Physics Building, Case School of Applied Science.

The meeting was held under the auspices of the following local committee in Cleveland:

Representing the National Lamp Works: Dr. W. E. Forsythe, *chairman;* Mr. L. C. Kent, Mr. C. D. Spencer, Mr. M. Luckiesh, Mr. A. H. Taylor, Dr. A. G. Worthing.

Representing Case School of Applied Science: Professor D. C. Miller.

Representing Western Reserve University: Professor H. W. Mountcastle.

Representing Warner and Swasey: Mr. Warner Seely.

In concluding its sessions the society tendered a most hearty vote of thanks to this committee as well as to the National Lamp Works, Case School of Applied Science, Western Reserve University, Warner and Swasey and the Cleveland Museum of Art for their efforts which resulted in a meeting generally admitted to be the most notable and successful in the history of the society.

About 50 persons attending the convention registered and obtained rooms at the Hotel Cleveland. The *registered* attendance at Case School was 78, of which 57 were from outside of Cleveland. The *actual* attendance was undoubtedly much greater than this. The number present at the sessions varied from about 50 to over 250.

SPECIAL FEATURES OF THE MEETING

The address of the retiring president, Dr. L. T. Troland, October 26, was on "The optics of the nervous system."

Other notable features of the meeting deserve special mention.

(1) Professor A. A. Michelson's paper on "The limit of accuracy in optical measurement" contributed by invitation on October 26: In introducing Professor Michelson, Professor D. C. Miller of Case School recalled in a very happy manner Professor Michelson's early connection with the department of physics at Case, mentioning his work on the velocity of light, the interferometer and the renowned experiment on "ether drift." He also exhibited as mementos of this early work parts of Professor Michelson's original apparatus. Before proceeding with his paper, Professor Michelson also recounted a number of interesting reminiscences of his first measurements of the velocity of light and the development of the interferometer. Over 250 persons heard Professor Michelson speak.

(2) Papers contributed by invitation by Professor E. L. Nichols as follows on October 26: "The spectral structure of the kathodoluminescence of metals in solid solution," by T. Tanaka; "On the spectra of incandescent oxides," by E. L. Nichols and L. J. Boardman.

(3) Visits to the Cleveland Museum of Art: The Cleveland Museum of Art is located in Wade Park only a short distance from Case School. On October 25, the director of the museum, Mr. Frederic Allen Whiting, addressed the meeting by invitation, and explained the work of the museum in a most interesting manner, dwelling particularly on "The optical problems of an art museum." He extended to all members and guests of the society a most cordial invitation to visit the museum. Many availed themselves of this opportunity to visit a museum which is notable and exceptional in many respects, and these visits contributed greatly to the pleasure and profit of attendance at the meeting.

(4) Visit to Nela Park: On the afternoon and evening of October 25th, members of the society were guests of the National Lamp Works at Nela Park. Parties were conducted through the Research Laboratories, the Laboratory of Applied Science and lamp factories and were given exceptional opportunities to observe the actual manufacture of lamp bulbs and lamps. In the evening a complimentary dinner given to the society by the National Lamp Works was followed by a symposium on light and lighting by Professor E. F. Nichols, Mr. Ward Harrison and Mr. M. Luckiesh and a beautiful experimental demonstration of the projection of mobile color patterns by Messrs. M. Luckiesh and A. H. Taylor, of the Nela Laboratory of Applied Science.

(5) Visit to Warner and Swasey: On October 27, the society visited the plant of Warner and Swasey, which is renowned for the construction of the largest astronomical telescope mountings in the world. Members were personally greeted by Mr. Swasey, who showed many objects of interest in his office. The mounting for the giant reflector which is just being completed for the Ohio Wesleyan University was on

exhibit on the floor of the shop and attracted great interest. The circular dividing engine and various pieces of optical interest made in the shop were also exhibited.

(6) Inspection of the laboratories of physics at Case School of Applied Science: On Thursday morning, Professor Miller welcomed the society and mentioned the principal apparatus of especial interest in the Case Physical Laboratories. During recesses of the meeting, many members visited the laboratories and inspected the instruments and apparatus.

(7) Society dinner: The annual dinner, held in the Rose Room of the Hotel Cleveland, on the evening of October 26th was a most enjoyable occasion. President Troland was toastmaster and the following speakers responded: Mr. Charles Brush, Professor A. A. Michelson, Professor D. C. Miller, Professor H. W. Mountcastle, Professor A. D. Cole, Professor Frank Allen, Professor C. A. Skinner, Dr. Hermann Kellner, Dr. Herbert E. Ives.

BUSINESS

The business meeting was held on October 25th.

The results of the election of officers for 1924–25 were declared by the president as follows: *President,* Herbert E. Ives; *vice-president,* W. E. Forsythe; *members of the executive council,* K. T. Compton, Theodore Lyman, P. G. Nutting, Fred E. Wright.

Informal reports of the secretary, the treasurer, the assistant editor and business manager, and the committee on preparing and publishing an English translation of Helmholtz's "Physiologic Optics" were accepted, it being understood that formal reports would be published later at suitable dates.

Brief oral reports of the following progress committees were presented and accepted: Colorimetry, E. A. Weaver, *chairman* (Report presented by Dr. Troland); Pyrometry, C. O. Fairchild, *chairman;* Refractometry, I. C. Gardner, *chairman*; Spectrophotometry, K. S. Gibson, *chairman*; Visual Sensitometry, H. M. Johnson, *chairman.*

PAPERS COMMUNICATED TO THE MEETING

The following is a list of papers contributed to the meeting in addition to papers mentioned specifically above:

The measurement of transmission in optical instruments: G. W. Moffitt and Paul B. Taylor.

Continuous motion to the dividing engine carriage: Wilmer Souder.

The "contrast" of developing-out papers: Lloyd A. Jones.

Color correction in image formation: T. Townsend Smith.

Theory of the optical lever and a new optical lever system: L. B. Tuckerman.

Aspherical lens systems: Ludwik Silberstein.

Optical collineation, independent of metrics: Ludwik Silberstein.

The brightness of the black body at the melting point of platinum: Herbert E. Ives.

On the verification of the principle of reflex visual sensations: M. S. Hollenberg.

On reflex visual sensations and color contrast: Frank Allen.

Color and luminosity: William Mayo Venable.

Apparatus for the determination of color in terms of dominant wave-length, purity and brightness: Irwin G. Priest.

A comparison of experimental values of dominant wave-length and purity with their values computed from the spectral distribution of the stimulus: Irwin G. Priest, K. S. Gibson and A. E. O. Munsell.

Some tests of the precision and reliability of measurements of spectral transmission by the Koenig-Martens spectrophotometer: Irwin G. Priest, H. J. McNicholas and M. Katherine Frehafer.

A rational CGS system of photometric units: Enoch Karrer.

Distortion of photographic film: F. E. Ross.

Some thermoelectrical properties of molybdenite: W. W. Coblentz.

Inner quantum numbers for the neutral helium atom: Arthur E. Ruark, Paul D. Foote and F. L. Mohler.

Regularities in the arc spectrum of iron: F. M. Walters, Jr.

The relation between the total thermal emissive power of a metal and its electrical resistivity: C. Davisson and J. R. Weeks.

The effect of heat on the figure of mirrors: Edison Pettit.

A thalofide cell pyrometer: Roderick B. Jones and Arthur C. Hardy.

An improved metallurgical microscope: L. V. Foster.

A new comparison prism for colorimeters of the Duboscq type: Hermann Kellner.

An apparatus for testing strain in glass slabs and finished prisms: Hermann Kellner.

A monochromator for mercury light: Hermann Kellner.

Camera lenses of large relative aperture for stellar spectrographs: G. W. Moffitt.

A prism for small broken telescopes: G. W. Moffitt.

Speed, constancy and accuracy of response to visual stimuli as related to the distribution of brightness: H. M. Johnson.

A variable sectored disk without gears and read directly without any auxiliary optical or electrical device: Enoch Karrer.

The complete proceedings of the meeting including abstracts of the above papers, will appear in the *Journal of the Optical Society of America and Review of Scientific Instruments.*

Irwin G. Priest,
Secretary

SCIENCE

VOL. LVIII DECEMBER 7, 1923 No. 1510

CONTENTS

SCIENCE: A Weekly Journal devoted to the Advancement of Science, edited by J. McKeen Cattell and published every Friday by

THE SCIENCE PRESS

Lancaster, Pa. Garrison, N. Y.
New York City: Grand Central Terminal.

Annual Subscription, $6.00. Single Copies, 15 Cts.

SCIENCE is the official organ of the American Association for the Advancement of Science. Information regarding membership in the association may be secured from the office of the permanent secretary, in the Smithsonian Institution Building, Washington, D. C.

Entered as second-class matter July 18, 1923, at the Post Office at Lancaster, Pa., under the Act of March 3, 1879.

SCIENCE AND ITS SERVICE TO MAN[1]

THE most striking feature of the world's history during the past hundred years is the extraordinary accession to man's knowledge of nature, the deepening of his insight into his own physical, intellectual and psychical characters and their correlations, and the recognition of the significance of environmental changes on his future earth-life. The twenty-three years of the present century show no sign of an abatement either in the rate of the extension of knowledge or in the significance of successive discoveries. The number of persons engaged on pure research, or on research into the possibilities of the application of scientific knowledge to human needs, was never greater than now. In many countries large sums have been devoted to reinforcing the means of carrying on these efforts, both as regards equipment and personnel. In not a few, men of wealth have vied with each other in creating and endowing great research laboratories, observatories and teaching institutions, and the financial means having been provided, personal devotion and qualification were not lacking.

One may well consider what this implies. The increase of human power through knowledge, the recognition of new resources in nature and of the means of utilizing them, and the enlarged ability to quicken and extend the boundaries of human relationships are such as disclose in some measure the peculiar significance of the past hundred years for future human life. The world has become indeed smaller, and touch between nation and nation speedier and greater. More clearly can it be seen that man has at his disposal very great, though practically unexplored resources; and he needs vision to see wherein opportunity lies. But increase of power carries also dangers which only fatuity can ignore. The Great War has revealed this unequivocally, and has signally shown that man's ability to wreck immensely transcends his power to ameliorate. So long as greed of wealth, national prejudices and readiness to misunderstand hold sway, so long will there be danger of this wreckage, and even upon a scale which more and more will greatly exceed the power of repair. The work of centuries may be destroyed in hours, of years in minutes. And it has, unfortunately, become more than ever a necessity to be prepared to destroy that one be not destroyed. To

[1] From the presidential address to the Australasian Association for the Advancement of Science at the New Zealand meeting.

this one may add that the exigencies of war involve the destruction of the fit: while sentiment often secures not only the survival of the unfit, but also even their reproduction. Truly, civilization may be wrecked by its own genius!

The quickening of human life and the extension of human powers call to young countries like the Dominion of New Zealand and the Commonwealth of Australia, rapidly growing into nationhood, for response in the details of their national life. For the short term of our civic existence, and judged by the average standards of the past century, we have perhaps done fairly well. That standard, however, is no longer adequate. Things are appropriately measured only by comparison; and one asks, therefore, "What, in the light of world-developments, are the scientific and other needs of Australasia to-day?" Our countries are, indeed, goodly heritages, and the right to them is effective occupation. None but the purblind can fail to note that the expansions of various populations are such that we here sorely need to survey our past development and our possible future in the light of world politics.

Considerations such as these put us upon inquiry and compel the question, "What part will Australasia play in extending and exploiting the realms of systematized knowledge, and in applying it to human needs?" I need hardly say that it is not enough merely to inherit the lore of the rest of the world; by our own contributions to the general store we must repay, or be classed among those who attempt to thrive on the genius of others.

There are, of course, among us those to whom the splendid generosities of the patrons of science call for no response of gratitude, and governments whose vision rises to that of statesmanship in providing for a better future in scientific inquiry are in their opinion but lavish and foolish. There are, however, also those who recognize that the British races must in the future—more than in the past—react to the fact that systematized knowledge is playing a rôle of new and ever-growing significance in world-affairs. Without acute national danger we can no longer ignore the need for creating for the rising generation the opportunity to become more thoroughly conscious of what is known of nature, and to become, moreover, instinct with the disposition to apply knowledge to practical ends.

It is considerations such as those expressed which will govern this matter of my address on this occasion, and I would add that the destiny of Australasia calls upon us to attend immediately to many things in which we have as yet made only a beginning—among these our equipment for research and for instruction in the whole range of the sciences. In this connection be it said that it is not, however, the material results that are the main concern. The world in which we live and the physical creations of man are but tools at our disposal, of value for our training and self-expression. Moreover, we live in a world of rivalries—here generous, there cruel and unscrupulous—and our equipment in a knowledge of nature will be a great factor in our destiny. It is not inappropriate, therefore, to consider for a moment the intrinsic character of that knowledge upon which so much depends, and at the head of which stands what has been called the "queen of the sciences," *Mathematica*, and her no less splendid sister, *Astronomia*.

I propose, then, to refer not only to the intrinsic nature of science, and to the need for creating and nurturing institutions for pure research and for inquiry into possible applications of its results to practical ends, but also to certain notable features of its recent developments.

THE NATURE OF THE HIGHER ELEMENTS OF SCIENCE

The essential elements of any science are, as it were, the basis of its higher claim upon our attention. Nevertheless, it may serve material ends. Thus mathematics and astronomy, for example, while of great value in relation to physical life—the first in the reach of its applications in physics, electricity, engineering, metallurgy, chemistry, biology, and so on, and the latter because of its services in regard to navigation, time, etc.—are of the highest value as ends in themselves, as indeed also are the higher elements of every other science. They provide a nobler discipline for the mind.

It is, moreover, a curious fact in the history of science that great discoveries have been made not by those who were thinking of practical applications, but by those whose sole aim was to reach a deeper understanding of nature. Minerva bestows her favors not on those who think they may use her to obtain a sort of Pandora's box, but on those who worship her for herself. The highest product of civilization is not the mere maintenance of man on the planet, but such maintenance as makes him a student of that vast universe of which physically he forms so utterly insignificant a part—a student, developing faculties by means of which he can appreciate beauty, magnificence, majesty, and, indeed, the whole range of things spiritually apperceived or intellectually grasped—a student capable of solving the most apparently hopeless problems.

Epoch-making conceptions flash into the mysterious world of mind as meteors in the celestial vault, and humanity is then enriched. Often revolutionizing older conceptions, their significance is in some measure realized by the prepared minds through whom they come. When a Heraclitus or a Bergson is overwhelmed with the fact that the problem of ontology

is summed up in the phrase παντα ῥεῖ, a philosophy has been created. When an Archimedes bursts forth with his εὕρηκα εὕρηκα, a conception of far-reaching consequence is added to the science of physics. A Newton, seizing the idea of universal gravitation, develops the *Principia,* said by Laplace to be the greatest monument of human genius ever created. A Carnot, a Joule, a Mayer lays the foundations of the theory of heat; an Abel, reenvisaging the work of Legendre, establishes a new branch of mathematics. A Poincaré, stepping into a carriage, grasps a new mathematical truth; his technical command of mathematical reasoning enables him to establish it formally. Illustration after illustration could be given of the fact that it is to the cultivated mind that the truth appears, and so appears that its place in the world of knowledge is recognized.

The importance of a scientific conception inheres in two things: one is that it coordinates and thus systematizes our theoretical constructions of nature, making it possible to keep the manifold of phenomena within our grasp; the other, that it confers creative power in our dealing with matter. One may perhaps refer for a moment to the latter aspect.

The Creative Power of Science

It was well said by Stieglitz, of Chicago, that "it is important . . . that the public should awaken to a clear realization of what the science of chemistry really means to mankind, to the realization that its wizardry permeates the whole life of the nation as a vitalizing, protective and constructive agent." He urged that the layman should understand that chemistry is the "fundamental science in the transformation of matter." To justify this dictum fully one must, no doubt, substitute for "chemistry" a wider term. It is to chemistry coupled with mathematics, physics and technology generally that the dictum more truly applies.

We are, of course, apt to see more clearly the significance only of the realms of knowledge with which we are best acquainted. The field of acute vision is restricted, and the *fovea centralis* of the specialist eye can hardly be expected to embrace the world-picture. Thus, when with great lucidity Berthelot said that "chemistry creates its object" he spoke truly; when he added that it possesses this creative faculty in a more eminent degree than the other sciences, that assertion may be regarded as applicable rather to what may be called the "larger chemistry" than to chemistry in the more restricted sense.

The observation that "science" is creative is, however, just, if the word be understood in the sense of "systematized and coordinated knowledge." Certain branches of knowledge are but little more than a systematic record of facts—*i.e.*, they are in a broad sense "descriptive"—and their accumulation is somewhat of the nature of cataloguing, while others penetrate to the inner significance of things and result in new and fecund constructions of the world-concept. In short, one may say that science is three-phased: it is descriptive, analytic and synthetic. It is preeminently to the synthetic phase that we are most deeply indebted for creative power. Thus, one may say that the discoveries of the small shell-fishes that furnished Tyrian purple (*Ianthina, Purpura* and *Murex*) are overmatched by the chemist who synthetically made the identical but purer substance dibromindigo.[2] Nevertheless, it is well to remember that the descriptive and analytical elements are, after all, necessary means to an end.

In the broader view we see that we owe to science not merely the products of synthetic chemistry, the multitude of chemical and pharmaceutical products, the myriads of splendid dyes, the perfumes and flavoring-substances, the explosives, the viscoses, celluloids, xylonites, bakelites, etc., but the various metallurgical processes, the steels and alloys that have made practicable, and have greatly cheapened, construction, and that have created new possibilities in manufacture. Other things being equal, the people whose national equipment includes the creative laboratories, the people whose instinct is to explore the great world about them in order to know and understand its nature, the people who desire to exploit its resources, using its crude substance as raw material with which to fashion things for its requirements—these are they who must become dominant. That is in the very nature of the case. In short, not in physical toil lies the secret of national success, but in intellectual achievement in the realm of nature-knowledge and in the power attained through such achievement.

The field of exploration in nature embraces now the micro-world of the subatomic as well as the vast depths of space. Man's senses are limited, and he has been forced to extend their range by artifice.

The Need for Research

Education in the proper sense does not merely involve the acquisition of the immense stores of information now available, but also—and this is supremely important—the development of *faculty*; *i.e.*, power and facility in the use of the acquired knowledge, and the awakening of insight and inventiveness, a love for inquiry into natural phenomena and for the systematizing of knowledge. It has been fortunate for the world that individuals have devoted very large sums of money for the purposes of research—

[2] The color secreted by the shell-fish is 6:6′ dibromindigo, and is not as fine as the 5:5′ dibromindigo manufactured cheaply by the synthetic chemist in large quantities.

e.g., Prince Demidoff in Russia; Lick, Rogers, Rockefeller, Carnegie, etc., in the United States of America; the late Prince of Monaco, etc.; and Cawthron here in New Zealand—and, owing to what the war revealed, governments have begun to realize that research is an essential for national safety and progress. For example, the British Government recently granted £1,000,000 for industrial-research associations, and over £200,000 for a fuel-research station, £35,000 on a low-temperature-research station, and during last financial year expended, moreover, £204,000 on the National Physical Laboratory. Japan is establishing a national-research laboratory at a cost of over £300,000, to which the Mikado himself contributed £100,000. One business firm alone in Germany, the Badische Soda-und-Anilin Fabrik, is said to have devoted no less than £1,000,000 and to have spent seventeen years in research before a satisfactory production of artificial indigo was achieved. At the beginning of this century Germany was paying annually £600,000 for indigo. At the outbreak of war she was selling annually £2,500,000 worth of dye. In the United States of America the annual expenditure on the Department of Agriculture alone is £7,506,000; the Carnegie Institution has a revenue of £220,000; the Mellon Institute for Industrial Research cost £100,000 to build and equip, and has an annual expenditure of £77,000. Among the efforts of business firms may be mentioned the General Electric Company, which has a research staff of 150 persons, and the Eastman Kodak Company, which spends annually about £30,000. The Pennsylvania Railway Companies' laboratories cost £60,000, and employ therein 360 persons on research.

In order that research in Australasia shall be what national progress and national safety demand two things are eminently desirable: (1) The more complete equipping, staffing and endowing of our universities and technical colleges, so as to enable research work to be carried on by the teaching staffs and graduate students; (2) the development and adequate equipment and endowment of a great research institute for Australia, so that it may fulfil the functions indicated in such an act as that creating the Institute of Science and Industry. Far removed from the centers of intense intellectual and scientific life, we stand in the greater need of such assistance; and the heritage which it is our privilege to possess will, for its retention and defense, need to produce far more material wealth, and to carry a population vastly greater than is ours at the present day.

I would point out that even in apparently simple matters research is needed. The need is often by no means so self-evident as is commonly imagined, and fatuous ignorance may regard it as unnecessary. It is easy, however, to multiply illustrations to the contrary. Will you permit me to make reference, by way of an instructive example, to a very commonplace matter—the elimination of what has been called "knock," "pinking" or "detonation" in internal-combustion engines. Independently, and as far back as 1881, Bertholet and Le Chatelier found that the propagation of flame in some mixtures of air and certain combustible gases, and in appropriate mixtures of oxygen with nearly all combustible gases, set up a detonation wave; Mallard and Le Chatelier later ascertaining that the development of this wave was always instantaneous, not progressive, and was marked by intense luminosity. The velocity of the wave was shown by Berthollet and Vieille to be constant, and Dixon held that during detonation the flame traveled with the velocity of sound at the temperature of the burning gases. Pressures of 25 to 78 atmospheres lasting an exceedingly brief period were produced, these being about four times as great as the maximum "effective pressure" developed by the explosion. The intensity of such detonation increases with the degree of the compression, with temperature, with advance of the spark-timing and with the extent of carbon deposits. Even when without danger it operates to reduce the efficiency of an engine, and as a consequence researches have been directed to means of reducing or eliminating it. Mathematical and physical examinations of the question showed that during normal combustion the pressure-differential is very small, but a flame-front moving with the velocity of sound produces an enormous pressure-differential, heard as the "knock." Iodine and certain organic compounds, containing selenium, tellurium, tin and lead, were found to retard the velocity of the combustion. When mixed with various fuels, benzene, which does not itself detonate even at compressions of, say, 14 or 15 atmospheres, reduces their tendency to detonation. Again, though present in the molecular proportion of only 1 in 50,000 of, say, kerosene-air mixture, diethyl telluride was found also to prevent detonation, and in the same circumstances lead-tetraethyl in the molecular proportion of only 1 in 215,000. One molecule of diethyl telluride was equal in effect to 330 molecules of benzene. When lead-tetraethyl is mixed to the extent of 1 volume with 1000 volumes of gasolene, perfect smoothness of running is secured.

Now, the mere recital of the above results shows that to attack even such an apparently simple question as "the best means of running an internal-combustion engine" an enormous amount of difficult research is required, and much ingenuity is demanded. But when the solution is attained the economic and general advantages are very great indeed.[3]

[3] See the researches of Midgley and Boyd, of the General Motor Research Corporation, Dayton, Ohio.

I will give another instance, an unsolved problem so far—*viz.*, the production of *light without heat.* Any notable increasing of the efficiency of light-producing apparatus is self-evidently of high economic importance. The wave-lengths of visible light range between 7,600 and 4,000 Angström units (*viz.*, ten millionths of a millimeter), and ether undulations of wave-lengths outside those limits are practically valueless for lighting purposes. Moreover, even within such limits the relative intensities vary for different sources of light, being, for example, characteristically different for sunlight, the electric arc and gaslight. The problem of light-efficiency is that of insuring, in the production of radiant energy, that it shall lie wholly within the luminous limits, and, moreover, be so distributed therein that the maximum luminosity shall be obtained; this last depending, however, upon the subject—*viz.*, man of normal vision. (It is different for color-blind persons, and in general for those possessed of vision which is in any way abnormal.) Research has shown that a 4-watt carbon glow-lamp has a luminous efficiency of only 0.43 per cent., while the luminous efficiency of the firefly is no less than 99.5 per cent. The most perfect of artificial illuminants has an efficiency of only about 4 per cent. —say, one twenty-fifth of that of the firefly. This fact has inspired a large number of investigations on the nature of light produced by plants or animals; about 290 papers have been written on the subject, and the distribution of light-producing organisms in the plant and animal kingdoms has been well ascertained.[4] There appears, however, to be no order in either in the distribution of the luminescence.

Using Nutting's light-sensibility curve (1911), Coblentz, Ives, Emerson and others deduced the number of lumens[5] per watt, and found it to be 2.6 for the carbon incandescent lamp, 8.0 for the tungsten, 19.6 for the "Mazda" of type C, 42.0 for the quartz-mercury arc, and no less than 629 for the firefly (*Photinus*). Newton Harvey has recently ascertained that of the photogenic substances, luciferase and luciferin, the former is probably a complex protein, the latter a natural proteose, or at least not a protein. The luciferases and luciferins obtained from closely allied forms will interact to produce light—*e.g.*, Photuris luciferin with Pyrophorus luciferase, and *vice versa*—but unless closely allied they may produce no light whatsoever.

The remarkable fact regarding luminescence is the very small amount of substances necessary to cause a visible emission of light: for example, the impinging of a single α particle—*i.e.*, a single helium atom—upon a crystal of zinc sulphide is readily seen as a bright flash. It has been found also that 1 part of luciferase in 1,700 million parts of water will give light when luciferin is added, and similarly in regard to a soluton of luciferin when luciferase is added. This figure is *not uncertain*, for assuming that the luminous gland of *Cypridina* is wholly luciferase, it has been experimentally verified. The action involves oxidation and is easily reversible, but the luminescence itself appears to depend upon the attainment of a certain reaction velocity. It may also be noted that the greater the concentration of luciferin the longer the luminescence lasts, and the greater the concentration of luciferase the shorter it lasts. Temperature has an effect, and there is an optimum value beyond which the light decreases again. The *Photinus* firefly emits an orange and the *Photuris* a greenish-yellow light, and different colors may be obtained by using different combinations of luciferases and luciferins.

The research, so far, does not appear to have yielded any solution of the practical problem of confining the production of energy wholly within the wave-lengths, which furnish a maximum luminescence and involve no losses through heat or actinism, etc. But they are a beginning, and are systematic, and I have no doubt that the present enormous waste of energy in the production of light will be overcome, if not by a continuation of this particular study, yet by studies which exemplify the methods of such researches as those here referred to.

Creation of a National Appreciation of Science

As a people we lack a due appreciation of systematized knowledge. The change must come through change of our environment. Its power, however, to affect our character, mental habit, etc., if it exists at all, diminishes with our age; hence the means by which a nation is to be so taught the physical sciences that interest therein will grow with the lapse of time must be called into requisition in the youngest years of individual lives. Nearly all young children appear by nature to have that inquisitiveness which constitutes the appropriate foundation of the scientific habit, and they instinctively follow the heuristic method with but slight leading. Elementary schools whose teachers had even a smattering of scientific knowledge, and whose equipment included the means of instruction in intuitional mathematics, in physics and chemistry, and in natural history, could—even in a generation—produce a change in the mental caste of the people. Scientific nescience on the part of the teaching staff could be made good by the issue of appropriate primers, the supply of apparatus, and by giving them special lectures. National destiny will

[4] It may be mentioned that luminosity may arise from bacterial infection, and in the case of a frog which had had a large meal of fireflies the light shone through his body.

[5] The flux emitted per steradian by a uniform point source of one "international candle."

be profoundly affected by this method; for by it we can develop an instinctive disposition to rely upon the aids which science can afford in practical affairs.

The aim of a good educational system is to engender an interest in the world of mind and in its physical environment so as to ensure our being advised as to what is already known, and being endowed so as to be able to utilize the resources of nature, thus making us alert to the opportunities about us; this assuredly not in order that we may live more luxuriously, but that we may live—so to speak—more expressively.

The more advanced elements of this system will be a good series of text-books, appropriate apparatus for schools and colleges, qualified teachers, well-equipped and adequately staffed technical colleges and universities, so that the staffs shall have abundant time for research and for guiding post-graduate work. The means for carrying out such research is also sorely needed. Beyond this the scientific departments of government—*e.g.*, agriculture, etc.—would require staffs to carry on their appropriate researches, in addition to their routine duties. Finally, as before said, we need institutes for pure research, and also institutes concerned both with research and with all applications of science to industry. To these institutes persons interested might go freely for guidance, at a payment only of such fees as are needed to prevent unreasonable use of the institution. If the world be so organized as to admit of it, it were better to find hundreds of millions for such work as this than for perpetual readiness to destroy. The education and control of peoples; the means of solving the social, economic and financial problems of international life; the question of control and distribution of populations; the inauguration of a scheme of national and international life in which a spirit of service shall take the place of the spirit of merciless competition—these will need all the elements of the problems to be under review, and will call for the exercises of the most complete knowledge both of external nature and of human character. The alternative would appear to be wreckage and the spread of poisons and of disease, and these might even destroy civilization, so that knowledge, instead of having rendered noble service, would have cursed the world whose genius had called it into being.

Our hope is to see a new spirit born here. One may ask, to what end? It may be that we can not say. No one knows what lies on the knees of the gods. But there is something within the mind and heart of any great people that responds to the dream of excellence, and inflames when the vision of national destiny is before it. Our mother-land has had a great past. Is its offspring here in southern seas, illumined by "the gem-pointed cross and the blazing pomp of Orion," to rise to material, to intellectual and to moral greatness among earth's peoples? If so, the path is strenuous but glorious. All visions of ease and luxury are but opiates and lead to destruction. We shall need to gird ourselves for the task, and create for ourselves a world where our sons, knowing something of the splendid mysteries of the boundless universe, and also of our own little world, will excel in the art of using to the full the heritage our nation has given us. Then, indeed, will science have rendered noble service to the sons of Australasia.

George H. Knibbs
Institute of Science and Industry,
Australia

H. FREEMAN STECKER

In the death of Dr. H. Freeman Stecker, ranked as one of the leading mathematicians of the world, which occurred after six months of illness, in the Mercy Hospital, Baltimore, on October 29, the Pennsylvania State College lost one of its best known scientist faculty members. He had served the college for twenty years, and in that time presented over twenty papers on mathematical subjects.

The following memorial was spread upon the minutes of the faculty organization of the School of the Liberal Arts at the Pennsylvania State College at a recent meeting:

The School of the Liberal Arts of the Pennsylvania State College, wishing to place upon its records a memorial tribute to the worth and work of Dr. Henry Freeman Stecker and to give expression to the distinct sense of professional loss which the college and school have sustained in the passing of our friend and colleague, adopts the following minute:

Dr. Henry Freeman Stecker was born at Sheboygan, Wisconsin, June 3rd, 1867, and died in the Mercy Hospital at Baltimore, October 29th, 1923. He entered the University of Wisconsin in 1889, receiving the degree of Bachelor of Science in 1893; Master of Science in 1894, and Doctor of Philosophy in 1897. He was also fellow in mathematics 1893 to 1895, and honorary fellow in 1897. During the academic year, 1900–1901, he studied at the Universities of Göttingen and Berlin. He also spent the summers of 1911 and 1912 in Paris attending lectures on mathematics, and on the latter occasion participated in the meeting at Cambridge, England, of the International Congress of Mathematicians.

His career as a teacher began in his undergraduate days, as assistant in mathematics, 1890–1895. He served at Northwestern University from 1897 to 1900, and after his year of study abroad was called to Cornell University as instructor in mathematics, where he remained until 1903. In the fall of that year, he was elected to an instructorship at the Pennsylvania State College, and by zeal and devotion to his profession rose in academic rank and preferment to a full professorship in mathematics. Dr. Stecker was a member of Sigma Xi, and of the fol-

[illegible]: American Mathematical Society, London Mathematical Society, Société Mathématique de France, Mathematischer Verein, and Circulo Matematico di Palermo. By his professional peers, Dr. Stecker was ranked as among the leading mathematical scholars of his time. His principal researches were in pure mathematics, geodetic lines, non-Euclidean geometry, foundations of geometry, line geometry and integral equations.

As we, his colleagues, think of Dr. Stecker, the quality uppermost in his twenty years of service at the Pennsylvania State College was the combination in a rare degree of scholar and teacher. He exacted of himself the highest standard of thoroughness and mastership, and he expected and received in a marked way like response from his students. Rigidly intolerant of sham anywhere, he has contributed his part to our Penn State spirit of honest, consistent work in the tasks of each day. A certain temperamental reserve and dignity of demeanor in his relations rendered all the more significant that deeper spirit of helpfulness and friendly cooperation which so many students and teachers have shared with him. He always stood for high standards of scholarship and moral conduct. Thoroughness, the discipline of mastering difficulties, the value of intellectual work fairly possessed him.

With all this, Dr. Stecker valued the amenities of life as well as its severe science; and his study of art, to choose one example, bore fruit in the community. It is no mere accident that his most intimate contact for many years with college athletics was with those who strove in the closest hand-to-hand encounters in boxing and wrestling. His whole career as student and teacher, even his heroic attitude in fatal illness, reveal a personality which loved the struggle of life, and which valued a man who strove with and conquered all difficulties with a brave heart and an earnest soul.

We, his colleagues of the School of the Liberal Arts, point with just pride to Dr. Stecker's twenty years of faithful service for Penn State, to his professional zeal which made him so widely known as a mathematician, and to his qualities as a man, whose thoroughness, faithfulness and honest toil are now a part of our college heritage.

It is further voted that a copy of this Memorial of the School of the Liberal Arts be transmitted with sincere expressions of deepest sympathy to Mrs. H. F. Stecker.

By the Committee,
JOSEPH H. TUDOR,
LUCRETIA VAN TUYL SIMMONS,
ERWIN W. RUNKLE,
Chairman

November 3rd, 1923

SCIENTIFIC EVENTS

THE SILLIMAN LECTURES AT YALE UNIVERSITY

In the Silliman lectures delivered at Yale University on November 6, 7, 8, 13, 14 and 15, Niels Bohr, professor of physics at the University of Copenhagen and winner of the Nobel Prize in Physics in 1922, developed the fundamental concepts underlying the application of the quantum theory to problems of atomic structure and showed how it has been possible to account to a considerable extent for the characteristic relationships between the elements, as summarized in the periodic table.

The first lecture was devoted to a discussion of the nature of these relationships and a statement of the program of atomic physics in accounting for them. The pioneer work of Dalton, Mendeleeff and Lothar Meyer has given us the natural system of the elements, and more recent work has shown the fundamental significance of the atomic numbers for the arrangement of the elements in this system. The combination rule and the simplicity of the formulas for series point to the basic importance of spectroscopic data for the interpretation of the properties of matter. The discovery of the electron and the atomic nucleus have led to a definite picture of the constitution of the atom, and we now know that the number of electrons around the nucleus in the neutral atom is equal to the atomic number. Due to the peculiar nature of the atomic system, it is possible to distinguish between two classes of properties—the radioactive properties, which are located in the nucleus and the ordinary physical and chemical properties, which are located in the outer electronic system and depend only on the total nuclear charge or atomic number. The program of atomic physics in the future is, then, to attempt to account for the characteristic relationships between the elements by means of considerations based on pure numbers. To do this, however, it is necessary to depart from the classical concepts of mechanics and electrodynamics which are unable to account for the stability of atoms or the origin of spectra.

The character of these new concepts as pointed out in the second lecture is suggested by Planck's theory of temperature radiation and Einstein's work on specific heats and the photoelectric effect in which it is necessary to introduce the hypothesis of the emission and absorption of energy in quanta. By means of two fundamental postulates proposed by the lecturer in 1913 which are based on the ideas of the quantum theory it has been possible to account immediately for the stability of atoms and to obtain an interpretation of the combination principle which makes possible the use of spectroscopic data for the investigation of the structure of atoms. These postulates assume the existence of stationary states within the atom which are fixed by certain conditions, and the emission of radiation by transition between them. It is possible to account in this way for the spectra of hydrogen and ionized helium in all details and to obtain an understanding of the general character of the relationships between the elements.

In the third lecture the remarkable confirmation which these postulates have received from experiments on the bombardment of atoms with electrons and the emission and absorption of spectral lines was discussed in some detail.

The fourth and fifth lectures were devoted to an account of the formal development of the theory. It has been possible to obtain a general method for the fixation of the stationary states of systems with certain periodicity properties, and to establish a connection between the frequencies, intensities and polarization of spectral lines and the motion in the stationary states which in the limit corresponds to that existing in the classical theory. In this way it has been possible to account in all details for the fine-structure of the spectra of hydrogen and ionized helium as well as the effect of electric and magnetic fields on these spectra.

In the last lecture it was shown how it has been possible by means of the interpretation of spectra afforded by the theory to obtain a picture of the way in which the atoms of all the elements are built up. This picture affords an understanding of the characteristic relations between the properties of the elements, and may be said to be at least the first step in the accomplishment of the program of atomic physics.

THE EXPEDITION TO TIBET OF THE NATIONAL GEOGRAPHIC SOCIETY

Joseph F. Rock, leader of the expedition to Tibet of the National Geographic Society, in a recent report to the Society, states that he has collected 914 kinds of Rhododendrons. The collection includes Rhododendrons from the richest indigo blue to orange yellow, crimson and absolutely black flowered species. It includes trees of thirty feet to prostrate plants two or three inches high. The leaves are as different as the flowers.

Mr. Rock is doing his plant collecting despite constant menace of outlaws. When he arrived at Likiang, his Yunnan province headquarters, he found 1,200 bandits encamped just north of the town, ready at any moment to sack it. He estimates there were 30,000 bandits in Yunnan alone, in August, not counting the numerous Tibetan border brigands.

Mr. Rock writes: "I am working with 23 men. Caravans are high and it is difficult to get any, no matter what one offers. The muleteers are afraid the robbers will take their mules and if the robbers don't intervene Chinese military officials may commandeer them for months without pay."

An added romance of plant hunting attaches to the shipments from this expedition because of the long, long trail they must travel to reach this country. One consignment of specimens first had to be dragged up and down lofty mountain ranges and borne through deep gorges and dense jungles for 28 days, from Nguluko to Tengyueh. Thence it went to Bhamo and from there was shipped down the Irrawaddy to begin its trans-ocean voyage.

Mr. Rock covered one unknown region, between Yunlung and Cheechuan, along the Hpi Kiang River, not yet on any map. He made his way along the Yangtze Gorge, 13,000 feet deep, and explored Mount Dyiualoko, 20,000 feet, and Haba Shan and Chiantashan, each about 18,000 feet. It is from the mountain slopes that plants are being shipped which will be suitable for planting in Glacier National Park.

The first pictures obtained of the priests of the mysterious, bejewelled Moso tribesmen were taken by Mr. Rock, showing these dignitaries in their curious dances and devil-exorcising ceremonies.

The range of plant explorations so far has covered the upper Mekong, Salwin, Yangtze and the Salwin-Irrawaddy divide. One objective of the expedition is to find a blight-resisting chestnut tree. Mr. Rock writes that he is shipping a species of the Castanopsis (related to the chestnuts) which develops trees with trunks from 4 to 6 feet in diameter. He adds: "*Pinus armandi* is a stately tree, the cones are huge and the seeds large and delicious. I shall send you a mule load."

THE EDWARD WILLIAMS MORLEY CUP

Through the generosity of Alpha Chi Sigma, professional chemistry fraternity, a cup in honor of Professor E. W. Morley, emeritus professor of chemistry at Western Reserve University, who died last February, has been offered to the freshman student in chemistry who attains the highest standing for the year. The award will be based on classroom work, laboratory work and general interest in the science. The prize will be known as the "Edward Williams Morley Cup."

The letter, addressed to Professor William McPherson of the department of chemistry and dean of the Graduate School, giving the details of the award, follows:

My dear Dr. McPherson:

It is the pleasure of the Lambda Chapter of Alpha Chi Sigma to present to the department of chemistry, the Ohio State University, a scholarship cup to be awarded in accordance with the following conditions:

1. The scholarship cup shall be awarded to that student in freshman chemistry who is regarded as the leader of the class judged from his records, both in the classroom and in the laboratory and from his general interest in the science.

2. This cup shall be awarded annually at the end of the spring quarter and the recipient shall be the permanent possessor of the same.

3. This cup shall be known as the Edward Williams Morley Cup, in honor of that great American teacher and

investigators whose work was carried on largely in the State of Ohio.

4. The committee of award shall consist of the following persons:

Professor William McPherson, Professor William Lloyd Evans, and one active member selected by the Lambda chapter of Alpha Chi Sigma.

The Lambda chapter respectfully submits the foregoing and trusts that the suggestions will meet with your approval.

Very truly yours,

The Committee on a scholarship award of Alpha Chi Sigma.

FREDERICK W. MACLAREN, *chairman*,
RAYMOND E. CARTER, *president*,
GEORGE W. RUHL,
CHARLES C. CLARK.

THE NOBEL PRIZE IN PHYSICS

As was announced recently the Nobel Prize in physics for 1923 has been awarded to Dr. R. A. Millikan of the California Institute of Technology. Previous awards of the prize in physics have been as follows:

In 1901: to Professor W. C. Röntgen, Munich, for the discovery of the rays subsequently named after him.

In 1902: in two equal shares to Professor H. A. Lorentz, Leiden, and Professor P. Zeeman, Amsterdam, for researches upon the influence of magnetism on the phenomenon of radiation.

In 1903: one half to H. A. Becquerel, professor at École Polytechnique, Paris, for the discovery of spontaneous radio-activity and the other half to Professor P. Curie and Mme. Marie Curie, Paris, for their united work of investigation respecting the phenomena of radiation discovered by Professor Becquerel.

In 1904: to Lord Rayleigh, London, for his researches respecting the density of the most important gases and his discovery of argon made in connection therewith.

In 1905: to Professor P. Lenard, Kiel, for his investigations of cathode rays.

In 1906: to Professor J. J. Thomson, Cambridge, England, for his investigations, theoretical and experimental, concerning the passage of electricity through gases.

In 1907: to Professor A. A. Michelson, Chicago, for his optical instruments of precision and his spectroscopic and metrological investigations carried out therewith.

In 1908: to Professor G. Lippmann, Paris, for his method, based upon the phenomenon of interference, of photographically reproducing colors.

In 1909: one half each to G. Marconi, Engineer, London, and Professor F. Braun, Strassburg, for their contributions to the development of wireless telegraphy.

In 1910: to J. D. van der Waals, Professor Emeritus, Amsterdam, for his labors respecting the equation of state for gases and liquids.

In 1911: to Professor W. Wien, Würzburg, for his discoveries relative to the laws of heat radiation.

In 1912: to G. Dalén, Superintendent Engineer, Stockholm, for his inventions of self-acting regulaters for use in conjunction with gas accumulators in providing illuminants for lighthouses and lighting-buoys.

In 1913: to Professor H. Kamerlingh Onnes, Leiden, *for his researches upon the properties of matter at low* temperatures, which among other results led to the production of liquid helium.

In 1914: to Professor M. von Laue, Frankfort-on-Main, for his discovery of the diffraction of Röntgen rays in crystals.

In 1915: in two equal shares to Professor W. H. Bragg, London, and W. L. Bragg, Cambridge, England, for the results of their labors in investigating crystal structures by means of Röntgen rays.

In 1916: the prize was not awarded.

The prize for 1917: was awarded in 1918 to Professor Ch. G. Barkla, Edinburgh, for his discovery of the characteristic Röntgen radiation of the chemical elements.

The prize for 1918: was awarded in 1919 to Professor M. Planck, Berlin, for the services rendered to the development of physics by his discovery of the elementary quanta.

In 1919: to Professor J. Stark, Greifswald, for his discovery of the Doppler effect with canal rays and of the decomposition of spectrum lines by electric fields.

In 1920: to Director Ch. E. Guillaume, Sèvres, in recognition of the services he has rendered to the attainment of exact measurements in physics through his discovery of anomalies in nickel steel alloys.

In 1921: to Professor Albert Einstein, of the University of Berlin, for his work in relativity.

In 1922: to Professor Niels Bohr, of the University of Copenhagen, for his work on problems of atomic structure.

THE CENTENARY OF JOSEPH LEIDY

THERE was held on Thursday, December 6, a meeting in Philadelphia to commemorate the centenary of the birth of Joseph Leidy. The following program was arranged:

(At the Academy of Natural Sciences)

Opening remarks: By the honorary chairman, DR. R. A. F. PENROSE, Jr., president of the Academy of Natural Sciences of Philadelphia.

Presentation of delegates.

General estimate of Leidy's influence upon scientific thought and development: DR. EDWARD S. MORSE, Peabody Academy of Science, Salem, Massachusetts.

Zoological work: DR. HERBERT S. JENNINGS, Johns Hopkins University.

1:30 P. M. Luncheon
Exhibition of Leidyana
2:30 P. M.

Paleontological and geological work: DR. WILLIAM B. SCOTT, Princeton University.

Botanical work: DR. WITMER STONE, The Academy of Natural Sciences of Philadelphia.

Mineralogical work: DR. FRANK W. CLARKE, United States Geological Survey.

Announcement of the Leidy Medal Foundation in the Natural Sciences

8:15 P. M.

(In the Mitchell Hall of the College of Physicians, Twenty-second above Chestnut Street)

The Joseph Leidy lecture in science: PROFESSOR HENRY FAIRFIELD OSBORN, president of the American Museum

of Natural History, New York City (under the University of Pennsylvania Foundation).

Personal recollections and appreciation of his work as an anatomist: Dr. George E. de Schweinitz, University of Pennsylvania.

Leidy's influence on medical science: Dr. Hobart A. Hare, Jefferson Medical College.

SCIENTIFIC NOTES AND NEWS

As has been noted in Science, the University of Paris at its opening session on November 24, conferred its honorary doctorate on Dr. W. W. Keen, of Philadelphia. In medicine the degree was also conferred on Professor Camilo Golgi, of the University of Pavia. In the sciences the degree was conferred on Sir J. J. Thomson, of the University of Cambridge; Professor Svante Arrhenius, of the University of Stockholm, and Professor Torres y Quevedo, of the University of Madrid.

A bill providing for an annual allowance of 40,000 francs for Madame Curie was presented to the French Parliament on November 23 by the minister of public instruction in connection with the coming celebration of the twenty-fifth anniversary of the discovery of radium.

The honorary degree of doctor of laws was conferred on Dr. J. G. Adami, vice-chancellor of the University of Liverpool, on the occasion of the installation of Lord Crawford and Balcarres, as chancellor of the University of Manchester.

A banquet in honor of Drs. Banting, Best and Macleod was given by the University of Toronto at Hart House, on November 26.

The Swedish Academy of Engineering Science has awarded its gold medal to the engineers, MM. Holmstroem and Malmberg, the inventors of a contrivance called a carbometer, by means of which it is claimed to be possible to tell at any moment in the manufacture of steel the exact carbon percentage in the mass of metal.

Sir Frank Dyson has been appointed to represent the International Astronomical Union on the International Research Council.

M. J. Breton, member of the institute and director of the national bureau of scientific and industrial research and inventions, succeeds the late M. Violle as president of the French Commission Supérieure des Inventions.

Dr. Charles K. Mills, of Philadelphia, has been elected president of the American Neurological Association for the ensuing year in succession to Dr. Harvey Cushing, of the Harvard Medical School.

S. H. McCrory, chief of the division of agricultural engineering of the U. S. Department of Agriculture, has been elected president of the American Society of Agricultural Engineers.

Dr. Warren Fred Faragher has been appointed an assistant director of Mellon Institute of Industrial Research of the University of Pittsburgh. Dr. Faragher, who went to the institute in 1918 and is now in supervisory charge of its scientific investigations in petroleum technology, will begin his new work on December 1. Dr. W. A. Gruse will succeed him in his present position.

C. C. Concannon, chief of the Chemical Division of the Department of Commerce, returned on the S. S. "America" November 10, having been abroad for six months.

Professor John L. Weber, of Cornell University, has taken a position in the Department of Conservation and Development of the State of New Jersey.

E. R. Alexander, at one time with the research and biological laboratory of E. R. Squibb, is the president of the Alexander Laboratories, just incorporated, in Kansas City, Mo. It expects to feature a product to prevent clouding of glass with moisture.

W. H. Dines retired last year from active supervision of the work on investigations of the upper air carried on at the observatory that he had established at Benson in Oxfordshire. It is now announced that the work will be transferred to the Kew Observatory.

Drs. R. Norris Shreve, W. Schmidtmann and W. P. TenEyck have organized the Ammonite Company in New York for the manufacture of ammonium salts.

Dr. Ashur Shupp, head fellow of the National Laundrymen's Association research at the Mellon Institute, has recently assumed technical charge of all of the laundries in Joliet, Illinois, under the auspices of the American Laundrymen's Association. The city laundries will constitute an experimental laboratory for the study of the laundry problem of the average city.

The Chemical Society of Washington has elected the following officers for the ensuing year: *President,* R. S. McBride, assistant editor of *Chemical and Metallurgical Engineering*; *secretary,* J. B. Reed, Bureau of Chemistry; *treasurer,* H. W. Houghton, Hygienic Laboratory. *Counselors,* R. B. Sossman, W. Mansfield Clark, Atherton Seidell and W. W. Skinner. The remaining members of the local executive committee will be L. H. Adams, William Blum, D. K. Chestnut, C. S. Lind, F. W. Smither and E. T. Wherry.

W. D. Bigelow, director of the National Canners' Association Laboratory, Washington, will be general chairman of the American Chemical Society convention committee for the spring meeting April 21 to 25,

1924, in Washington. W. M. Clark, of the Hygienic Laboratory, is vice-chairman. The subcommittee chairmen, who make up the general convention committee, are as follows: Atherton Seidell, finance; L. I. Shaw, registration; H. E. Howe, publicity; H. C. Fuller, hotels and transportation; R. S. McBride, entertainment; Guy Clinton, meeting rooms; L. H. Adams, excursions, and Mrs. H. E. Howe, ladies.

THE University of Alberta has received a grant of $10,000 from the Carnegie Foundation for research work by Dr. J. B. Collip, who was associated with Dr. F. G. Banting in the discovery of insulin.

PROFESSOR K. T. COMPTON, of Princeton University, addressed the New York Section of the American Chemical Society at Schenectady on November 23 on the subject, "Distribution of Mass and Charge in Molecules." The following day he spoke on "Catalytic Action of Excited Molecules" before the Colloquium of the General Electric Company.

TREAT B. JOHNSON, professor of organic chemistry in Yale University, gave a lecture on November 10 before the Chemistry Club of Mt. Holyoke College on "The chemistry of animal and plant cells."

DR. W. D. HARKINS, professor of physical chemistry at the University of Chicago, was the speaker at the opening meeting of the Purdue Section of the American Chemical Society on October 11. His subject was "The Building and Disintegration of Atoms, and the Photography of Atomic Collisions."

SIR OLIVER LODGE delivered the presidential address to the Röntgen Society on November 6 at a meeting held in the Institution of Electrical Engineers. The subject was "X-rays and the atom."

DR. ALEŠ HRDLIČKA, curator of the division of physical anthropology of the U. S. National Museum, gave an address before the Washington Academy of Sciences on October 19 on "Ancient Man in Europe."

DR. CHARLES K. CLARKE, medical director of the Canadian National Committee for Mental Hygiene, delivered the Maudsley lecture on "Psychiatry," recently, in London.

THE subjects discussed at the tenth French Congress on Hygiene, which convened at Paris on October 22, were "Hygiene in Transportation," "Bacteria from the Point of View of Biologic Purification," "Surveillance of Sources of Drinking Water" and "Garbage."

PARTS of the original chemical apparatus used by Louis Pasteur, in his experiments, are now at the University of Pennsylvania. They were brought to this country by Dr. John Frazer, dean of the Towne Scientific School, who recently returned from France, where he spent a year as exchange professor from six American universities. Through him the apparatus has been divided among the universities associated with Pennsylvania in the exchange of professorships of applied science between American and French universities.

THE memorial to the late Professor Sir German Sims Woodhead at the Cambridgeshire Tuberculosis Colony, Papworth Hall, consists of a new pathological laboratory and X-ray department. It was opened on November 22 by the Hon. Sir Arthur Stanley.

ALBERT REID LEDOUX, a past president of the American Institute of Mining and Metallurgical Engineers, died at Cornwall-on-Hudson, N. Y., October 25, in his seventy-first year.

DR. JAMES R. MCDOWELL, sixty-three years old, son-in-law and partner of the late John A. Brashear, maker of astronomical instruments, ended his life in his laboratory workshop on November 30.

THE Board of Trustees and the Corporation of the Marine Biological Laboratory at Woods Hole have passed the following minute:

> D. Blakely Hoar, treasurer of the Marine Biological Laboratory, died in Boston, March 8, 1923. Mr. Hoar first came into the office of treasurer in October, 1899, and served the laboratory in this capacity for almost twenty-four years. He began his duties during a very trying period in which the laboratory was reorganized, and under circumstances that must have been for him often little short of embarrassing. But he was not a man to be put down by such conditions, and from the beginning to the end of his term of service he gave to the affairs of the laboratory untiring interest and unswerving support. In the days of small things he exerted every effort to conserve our resources, and to make clear to many of us, who from our scientific bias may have thought otherwise, the wisdom of his course. He often expressed himself with earnest passion, yet always with a saving sense of humor and a generous patience. In him the laboratory loses a devoted and a loyal servant, and many of its members a valued friend.

THE honorary presidency of the Gorgas Memorial Institute of Tropical and Preventive Medicine has been accepted by President Coolidge, in a letter which was read before a meeting of the board of directors of the organization at the Pan-American Union Building, Washington, D. C., on November 13. The President's letter said in part:

> The organization stands for a world movement to bring the lands and climates of the tropical world into their fullest productivity and service to humanity. This is certain to be one of the great problems of the coming generations, increasingly insistent as the population of the temperate zones shall increase. One of the great accomplishments of the last half century has been the development of sanitary and medical procedures by which the tropics have been made available for the habitation of peoples acclimated to the temperate areas. General Gorgas will always be remembered as foremost among

those who have labored intelligently and effectively in this cause, and I am glad to be associated with an organization which proposes to project that great service into the future.

The Gorgas Memorial Institute which will be established at Panama City will have an endowment fund of $5,000,000 raised by popular subscription.

The Federation of American Societies of Experimental Biology will meet at St. Louis from December 27 to 29.

The International Union of Physics, which includes representatives from France, Belgium, Denmark, Japan, Poland and the United States, will hold its first general assembly at Paris from December 28 to 31.

An exposition organized in celebration of the fiftieth anniversary of the French Physical Society will be held in Paris during the first weeks of December.

We learn from the *Journal* of the American Medical Association that a group of northern Ohio residents have organized to establish a model health community and nerve rehabilitation center near Cleveland. The charter, which has been taken out under the name of the Psychiatric Foundation of the Western Reserve, will be on the order of the MacLean Institute, Boston; the Friends Hospital, Philadelphia, and the Sheppard and Pratt Hospital, near Baltimore. It is designed as a rest colony and research center. Laboratory equipment will be installed for the investigation of all phases of practical psychology, and the cause and treatment of nervous and mental ailments. The staff will comprise an experienced psychiatrist and a corps of physicians, nurses and aids. The institution will be heavily endowed and will be operated on a cost basis.

We learn from *Nature* that Professor J. J. R. Macleod, professor of physiology in the University of Toronto, who was recently awarded the Cameron prize for 1923, delivered two lectures in the University of Edinburgh on October 16 and 17, respectively, on the nature of control of the metabolism of carbohydrates in the animal body. He dealt with the discovery of insulin and its value in the investigation, not only of diabetes, but also of other problems of metabolism. The Cameron prize was founded in 1878, and is awarded to an investigator who in the course of the five years immediately preceding has made an important addition to practical therapeutics.

The Mayo Foundation, in cooperation with the local chapter of Sigma Xi and the universities of Wisconsin, Minnesota and Nebraska, and Washington University (St. Louis), has arranged a course of lectures to be given this autumn and winter on various phases of heredity. The first lecture was given October 29 at the University of Wisconsin by William Ernest Castle, professor of zoology at Harvard University, Boston, on "Heredity—the general problem and its historical setting." Professor Castle delivered the same lecture at Rochester on October 30, at Minneapolis on October 31, at Omaha on November 1, and at St. Louis on November 2. Other lectures were as follows: November 6, Professor John A. Detlefsen, Sc.D., of the Wistar Institute, Philadelphia, "The inheritance of acquired characteristics"; November 19, Miss Maud Slye, University of Chicago, "Heredity in relation to cancer," and December 4, Professor Harry Gideon Wells, University of Chicago, "Human cancer from the standpoint of heredity."

Arrangements are being made for a series of "symposia" at Harvard—meetings at which two or three members of the Harvard Faculty will discuss one scientific subject from different points of view. The first of these symposia was held on November 6. The subject was "The origin of life." The speakers and their topics were: (a) "Life throughout the universe," Harlow Shapley, Paine professor of practical astronomy and director of the Harvard College Observatory; (b) "Early phases of terrestrial life," Edward C. Jeffrey, professor of plant morphology; (c) "Life and spirit," Kirsopp Lake, Winn professor of ecclesiastical history. Early in December the second symposium will be held. The general title will be "Sound," and it is expected that the speakers will be Associate Professor Frederick A. Saunders, of the department of physics; Archibald T. Davison, associate professor of music, college organist and choir master; and Professor George H. Parker, of the department of zoology and director of the zoological laboratory.

The Special Board for Biology and Geology of the University of Cambridge have recommended that £100 per annum of the Worts Traveling Bachelors Fund should be subscribed to the Zoological Station at Naples. During the war and for some time afterwards the station passed under the control of the Italians, who appointed Professor Monticelli as president; but it has now reverted to the management of Dr. Rinehardt Dohrn, son of the founder of the station, who is now director, and is assisted by a committee thoroughly representative of Italian science and Italian affairs. The connection of Cambridge with the Naples laboratory has lasted unbroken for half a century.

EDUCATIONAL AND UNIVERSITY NOTES

Cornell University announces the receipt of a gift of $200,000 from an anonymous donor for the purpose of establishing an endowment fund, the pro-

[illegible] of which are to be devoted to research work in the department of pediatrics in Cornell University Medical College in New York City.

The trustees of Rutgers College, on October 12, received an anonymous gift of $150,000 for an addition to the Vorhees Library building.

In the will of the late William S. Richardson, who died October 6, the sum of $75,000 is left to the Massachusetts Homeopathic Hospital, Boston, on condition it keeps pace with the general advancement of medicine and surgery for the next five years. If the hospital is not progressive the fund will go equally to Harvard University and the Sulgrave Institution, which institutions are to receive the remainder of the $210,000 estate.

It is announced that the formal opening of the Atlanta Graduate School of Physicians and Surgeons will take place April 9, 1924. Dr. William Perrin Nicolson is dean, Dr. Garnett W. Quillian, vice-dean, and Dr. Michael Hoke, president of the faculty.

Edgar Allen, Ph.D., Washington University, St. Louis, has been appointed professor of anatomy at the University of Missouri School of Medicine, Columbia.

George R. Gage has been appointed an instructor in botany in the department of biology of DePauw University for the present year.

Dr. Ole N. deWeerdt has been appointed head of the department of psychology at Beloit College.

Dr. Irving S. Barksdale, Richmond, has been elected associate professor of physiology at the Medical College of South Carolina at Charleston.

DISCUSSION AND CORRESPONDENCE

SODIRO HERBARIUM

While at Quito I had the opportunity of examining the herbarium left by the well-known botanist, Sodiro, who brought together the only important collection of plants in Ecuador. The collection is housed at the Colegio de San Gabriel, a Jesuit institution, where it is appreciated and is being well kept. My examination was confined to the grasses, but I assume from the size and general appearance of the collection that all families are well represented.

The original Sodiro specimens are, for the most part, mounted and well labeled. Nearly all are accompanied in the herbarium by one to several duplicates, these being sometimes mounted but usually unmounted, lying in folders with the labeled specimen.

I was permitted to select a series of duplicates for the U. S. National Herbarium, for which I was charged ten dollars per hundred. Apparently the college is willing and anxious to dispose of the duplicates at the price mentioned. Those interested in Andean botany would do well to supply themselves. I am informed that the college has a collection of about 400 birds that it wishes to sell. Of the condition of these I know nothing. It will be of interest to botanists to know that the college has on hand extra copies of many of the publications of Sodiro which it wishes to sell. Father Mille, through whose kindness I was enabled to examine the herbarium, and who is the only Ecuadorean botanist interested in collecting, is adding to the Sodiro Herbarium.

All communications should be addressed to Father Luis Mille, Apertada 266, Quito, Ecuador.

A. S. Hitchcock

U. S. Department of Agriculture,
Guayaquil, Ecuador

A CLASS EXPERIMENT TO SHOW THE BEHAVIOR OF HEMOGLOBIN TOWARD VARIOUS GASES

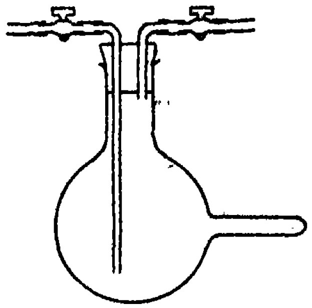
Two years ago I introduced into the laboratory work of my class in biochemistry at the University of Virginia a simple experiment which has proved so successful in making real to students the behavior of hemoglobin under exposure to various gases that I am passing it on to others. The points of special value in the experiment are: (1) avoidance of frothing of the laked blood by bubbling gases through it; (2) convenience in observation of the spectrum; and (3) ease of estimating the approximate and relative times required for the completion of the various reactions observed.

Into the side of a 250 cc balloon flask is fused a 10 x 80 mm test-tube; the size of test-tube is chosen so that it will fit into the holder of a direct vision hand spectroscope. The mouth of the flask is closed by a 2-hole stopper; glass inlet and outlet tubes, shown in the diagram, permit the passage of any gas through the flask. It is thus possible to spread a solution in a thin layer over the sides of the flask during aeration and to return it immediately to the test-tube for spectroscopic examination.

Laked blood is diluted with water until, when examined spectroscopically in a small test tube, two distinct and fairly deep absorption bands of oxyhemoglobin are seen. This oxyhemoglobin solution is then poured into the dry spectroscopic glass flask and the stopper made tight. Stop-cocks are provided on each piece of rubber tubing to insure exclusion of air during spectroscopic examinations.

A current of nitrogen, hydrogen or carbon dioxid is then passed through the flask while the laked blood is kept spread in thin layers on the walls by gentle rotation, and the reduction of the oxyhemoglobin to

hemoglobin observed both with the naked eye and spectroscopically. It is usually complete in a few (three to five) minutes with a moderately strong aerating current.



The immediate reverse change to oxyhemoglobin upon blowing through a current of air is then observed spectroscopically.

Carbon monoxid or illuminating gas is then passed through the flask and the very rapid change to carbonyl-hemoglobin observed both by the cherry red color on naked eye inspection and also spectroscopically. It goes without saying that this can be performed, starting either with hemoglobin or with oxyhemoglobin.

The change from carbonyl-hemoglobin to hemoglobin is then observed by the passage of a current of nitrogen, hydrogen or carbon dioxid. Usually it takes 15 or 20 minutes to effect the complete disappearance of the two carbonyl hemoglobin bands as compared with the three to five minutes required for the disappearance of the two oxyhemoglobin bands under identical conditions, thus visualizing to the student the difference in velocity of dissociation of oxyhemoglobin and carbonyl-hemoglobin.

That the combination of the hemoglobin with carbon monoxid has not changed its power of combination with oxygen is then readily demonstrated.

It is also instructive to require the student to explain why a current of nitrogen or other indifferent gas changes both oxyhemoglobin and carbonyl-hemoglobin to hemoglobin, while ammonium sulphide or Stokes reagent has this effect only with oxyhemoglobin.

The apparatus also obviously lends itself to other instructive demonstrations. When the aeration flask and test-tube are made strong enough and pressure tubing is employed the air pump may be used instead of the current of indifferent gas. The behavior of hemoglobin towards other gases, active and indifferent, as well as the influence of physico-chemical conditions in the solvent may similarly be studied.

These experiments bring home to the student that in all cases the common factor responsible for breaking up the combination of hemoglobin with active gases is the reduction of the partial pressure of the active gas in the solution. Practical physiological applications to the treatment of cases of gas poisoning are obvious.

THEODORE HOUGH

PHYSIOLOGICAL LABORATORY,
UNIVERSITY OF VIRGINIA

THE TRANSMISSION OF NEMATODE RESISTANCE IN THE PEACH

In the spring of 1919 the writer, at that time connected with the Georgia Experiment Station, planted peach seedlings grown from pits obtained from three sources in root-knot nematode infested soil at the Georgia Experiment Station.

One lot of pits was obtained from a tree on a farm near Tallahassee, Florida, a second lot was obtained near Cordele, Georgia, and the third lot was made up of seed from several trees growing at the experiment station.

During the summer it was observed that the seedlings from the Florida pits were growing more vigorously than those from the two lots of Georgia pits.

Examination of these trees in the fall of 1919 showed that the Florida seedlings were practically free from root-knots; while the seedlings from both lots of Georgia pits were heavily infested, thus accounting for their less vigorous growth.

The resistant peach seedlings were reset in nematode infested soil where they continued to make a vigorous growth during the season of 1920. Examination in the fall showed that these seedlings retained their resistance to the root-knot nematode as stated by the writer in the annual report of the Georgia Experiment Station.

Since the peach is not readily propagated except by seed nematode, resistance will have to be seed transmitted if much practical use is to be made of this resistance, so tests were planned to determine this point.

These resistant peach seedlings produced their first crop of fruit in the summer of 1921, and seed from these were tested in root-knot nematode infested soil in the summer of 1922. Pits from Belle of Georgia fruits were planted in the same soil as checks.

In the fall of 1922 the seedlings were dug and examined and it was found that the trees from Georgia Belle pits were heavily infested with root-knots, while the second generation Florida seedlings were free from root-knots. This indicates that this Florida seedling peach is resistant to the root-knot nematode and that the factor for resistance is seed transmitted.

Since July 1, 1922, the writer, as a member of the Tennessee Experiment Station, has continued this

investigation with a view to practical application, but it seems desirable to present this progress report to show the possibilities of root-knot nematode control through resistant fruit stocks.

J. A. McCLINTOCK

UNIVERSITY OF TENNESSEE
AGRICULTURAL EXPERIMENT STATION

QUOTATIONS

THE MASSACHUSETTS COLLEGE OF PHARMACY

OUTCOME of an association founded by Dr. Ephraim Eliot of Harvard one hundred years ago, the Massachusetts College of Pharmacy on November 15 observed the centennial of that organization, which is, in a sense, the centennial of the college. It was a day of many speeches. Running through them all was expression of the idea that the occupation of the pharmacist, whether or not it may properly be called a profession, has been raised to professional dignity and importance. Perhaps it is well for the public to be reminded of this fact in these days when many a drug store contains articles of vast variety in nowise connected with drugs and remedies. It is easy to forget that somewhere in such establishment are the men who have been scientifically trained in the compounding of remedies for human ills.

Significance of the anniversary as bearing upon the problems of youth was also indicated. Payson Smith, commissioner of education, spoke of the boys who are drifting from job to job trying to find their proper place in life. The vocational school, whether it be a college of pharmacy or whether it be devoted to instruction in other occupation, makes appeal to many a boy who might otherwise become one of the drifters, and introduces him to a life of greater usefulness.

The Massachusetts College of Pharmacy is fortunate in the possession of the building given it by the late George Robert White, whose great gift to Boston has made possible the creation of the proposed health units which were described by Mayor Curley in his remarks at yesterday's observance. These health centers in crowded sections of a great city suggest the opportunity which the pharmacist has in common with other citizens to devote time and energy to the public service. But in a larger sense the pharmacists as a body are in the public service, inasmuch as they stand with the physician in the battle with disease and the maintenance of the public health. It is therefore, cause for general satisfaction that institutions such as our own college of pharmacy are to be found in the land, giving their students the technical training which they need and emphasizing the ideals which should guide them in their chosen occupation.—*Boston Evening Transcript.*

SCIENTIFIC BOOKS

Publications of the Astronomical Observatory of the University of Michigan, Volume 3. Published by the Observatory, Ann Arbor, 1923. 270 pages, 16 plates.

THIS volume is a compilation of recent investigations of the Detroit Observatory, chiefly in the field of stellar spectroscopy. The opening papers are continuations of a series by R. H. Curtiss on "Studies of Class B stellar spectra containing emission lines." It is shown that the widths of the hydrogen emission lines in any one of these stars bears a nearly linear relation to the wave lengths and that the lines so plotted for the stars intersect not far from wave length 3270 A.; so that, if the width of one emission line is measured, those of others in the same spectrum may be calculated quite accurately.

In the second paper Professor Curtiss discusses, among other features of Class Bp stars, their evolutionary status. These stars may be said to stand apart from normal helium stars not merely as having more extensive atmospheres, but also because of the excitation of their atmospheres to luminosity. They may have developed uniquely along one of the current evolutionary sequences which he reviews; or, as seems to him more probable, they differ from other Class B stars by virture of a stimulus received by encounters with diffuse nebulosities and differing only in degree from that which produces the novae.

One of these stars, Kappa Draconis, is found to be a spectroscopic binary of a peculiar type. Broad emission and underlying absorption lines oscillate in a period of nine days; but the narrow absorption lines which divide the hydrogen emission, including also the narrow K line of calcium, do not share this oscillation. The orbit of the Class Bp star Sigma Cygni is calculated by F. Henroteau. Another paper by the same author deals with radial velocities of Boss's antapex group of stars. The preferential motion of this group is found in substantial accordance with Boss's conclusions.

It is interesting to find, in a paper by C. C. Kiess, a complete confirmation of the remarkable behavior of Alpha Canum Venaticorum, to which Ludendorff and Belopolsky called attention ten years ago. Two groups of faint lines, attributed by some writers to the rare earth elements, vary reciprocally in intensity, and certain of them yield variable velocities of the same period as the intensity variations; while the majority of the lines, including the more prominent ones, are apparently invariable in both respects. Moreover, maximum intensity occurs coincidently with maximum velocity of approach. It seems to the reviewer

to be obvious, especially when Guthnick's light curves for this star are recalled, that we have here an extraordinary case of Cepheid variation and one that should be taken into account in theories of this perplexing type of variable star. Doubtless this is not the only example of its kind.

Among the sixteen papers in this volume two others, at least, are especially noteworthy. Under the title: "New silicon lines in Class B stars," W. C. Rufus, R. A. Sawyer and R. F. Paton identify many lines of hitherto unknown origin in the spectra of helium stars. These disclosures originated in recent laboratory investigations with the vacuum spark, in the course of which the known number of silicon lines was increased fivefold. In the closing paper, R. H. Curtiss and D. B. McLaughlin discuss the results of their spectroscopic observations of comets, especially Delavan's comet of 1913. An advance in this field is marked by their success in deriving accurate radial velocities from the reflected solar spectrum of the comet.

Excellent enlargements of stellar spectra illustrate the volume, among them a beautiful series of Nova Geminorum II by Professor Curtiss and a very valuable sequence of typical spectra by Dr. Rufus.

Robert H. Baker

University of Illinois

SPECIAL ARTICLES

EVIDENCE OF A SPARK LINE IN THE LITHIUM SPECTRUM[1]

Experiments in this laboratory[2] have shown that the thermionic discharge in gas at low pressure is an effective means of exciting spark lines and that these lines are relatively strong at potentials only slightly greater than the critical voltage. The method has been applied to lithium vapor in an attempt to discover spark lines in this element. The design of discharge tube has been described elsewhere.[3]

Electrons from a tungsten cathode are accelerated by the potential applied between it and a nearby anode and the larger part of the electron path is in an equipotential region. The discharge is concentrated by the magnetic field (about 200 ampere turns) of a copper helix surrounding the tube. In this case the helix served at the same time as a heater to vaporize the lithium. Temperatures between 500° C. and 600° C. were used. The discharge was photographed with a large Hilger quartz spectograph.

Spectra were obtained at applied potentials ranging from 8 to 200 volts. The only noticeable change in the spectrum (apart from lines of known impurities) was the appearance near 50 volts of a line λ 2934.15 ± .1 I. A. This line appeared in one very long exposure at 45 volts. It was very faint at 55 and strong at 60 and above. The photographic density of the line at 100 volts was less than that of the fifth line of the principal series and greater than the sixth. Between 100 and 200 volts the intensity was only slightly increased.

The lithium used was not exceptionally pure. Sodium and hydrogen were always present. No likely impurity of the observed wave length is listed in Kayser's table of principal lines. A faint spark line of sodium is listed by Foote, Meggers and Mohler (*l. c.*) at λ 2934.4, but the absence of other stronger lines on the lithium plates excludes the possibility that the new line belongs to sodium. In one tube the lithium was contaminated with magnesium. The magnesium spark lines λ 2936.496 and λ 2928.625 were faintly visible on either side of the new line and served as convenient comparison standards. The plates were not, however, suitable for measurements of high precision.

To excite the spark spectrum of lithium the valence electron and one of the K electrons must be removed from the atom. Removal of the valence electron alone requires 5.3 volts and the potential for removal of the K electron alone we will call V_k. Removal of both by a single collision will require a potential greater than the sum of the two. The spark spectra of other alkalies are visible at the second ionization potential of the normal atom under conditions of current density comparable with those used with lithium, but are greatly enhanced at a potential four or five volts greater than this. This indicates that $V_k = 50$ volts with a probable error of at least 5 volts.

Holtsmark[4] and McLennan and Clark[5] have published critical potentials for the excitation of K radiation from solid lithium oxide and lithium. The former gives 52.8, the latter 42.4 volts. As the experiment is very difficult the results may be questioned without discrediting the ability of these physicists. However, the value here estimated for V_k is in agreement with Holtsmark's results.

The spark spectrum of lithium must resemble the arc spectrum of helium, but will have series terms from two to four times as great. Few lines will fall within the range of the quartz spectrograph. The line λ 2934 may correspond to the strong helium

[1] Published by permission of the Director of the Bureau of Standards of the U. S. Department of Commerce.

[2] Foote, Meggers and Mohler, "Enhanced spectrum of Mg.", *Phil. Mag.*, 42, p. 1002, 1921; "Enhanced spectra of Na and K," *Astro. Phys. J.*, 55, p. 145, 1922.

[3] Mohler and Ruark, "J O S A and R. S. I.", 7, p. 819, 1923.

[4] Holtsmark, *Phys. Zeits.*, 24, p. 225, 1923.

[5] McLennan and Clark, *Proc. Roy. Soc. A.*, 102, p. 389, 1923.

doublet $2s - 2p_{1,2}$, λλ 10829.1, 30.3. Until we have a satisfactory theory of the helium arc spectrum speculation as to the new line will be useless.

An interesting feature of the spectrum of the thermionic discharge in lithium is the unusual development of the subordinate series. Eleven lines of the sharp series and 16 of the diffuse were plainly seen on one of the plates. Only six and seven, respectively, are listed in tables of series lines. The principal series was recorded to the tenth line.

F. L. MOHLER

BUREAU OF STANDARDS

ON THE DISPERSITY OF SILVER HALIDES IN RELATION TO THEIR PHOTOGRAPHIC BEHAVIOR

IN an article appearing in SCIENCE for October 26, 1923, under the above heading, Dr. Frank E. Germann and Mr. Malcolm Hylan query a conclusion reached by Wightman, Trivelli and Sheppard, on the relation of grain size and photographic sensitivity. Their first questioning of the conclusion that the sensitivity increases with the grain size is based on an example quoted in "Monographs on the theory of photography," No. 1, p. 104, where comparison of two emulsions showed that the one having grains one third the linear dimensions was more than 19 times as fast and that the same was true of individual grains in the same emulsion. The explanation of this discrepancy has been amply provided subsequently by discoveries concerning the function of sensitive specks in the silver halide grains.[1]

They quote further the conclusion of Koch and DuPrel that "it is not possible to formulate any definite relationship between the grain size and sensitivity with the information at present available," to which it may be replied that very much more data are now available than were at hand at the time that Koch and DuPrel made their statement.

With regard to the theoretical considerations they advance, we find ourselves in considerable disagreement with them. They conclude, on the nuclear theory (without specifying what they mean by the nuclear theory), that the speed depends on the *number of grains affected* without reference, therefore, to the size of the grains. It can be seen from the work of Svedberg and others that this argument is entirely in contradiction with the present nuclear theory, since the number of specks or nuclei increase with the size of grain and, therefore, the chance of a grain being made developable by light increases with its size. As we have pointed out in other papers,[2] this result is independent of whether the continuous wave theory or the quantum theory of the constitution of light be adopted. The decision between these two theories must be reached on other grounds. Consequently, we can not agree that "theoretically the smaller grained emulsion should be the more sensitive," but rather the reverse. We may point out in this connection that the writers have not defined exactly what they mean by "sensitivity." Speed, in the usual photographic significance of the term, depends on density measurements, that is, on the number and size of the developed grains conjointly. Sensitivity can be determined microscopically from counts of grains independently of density measurements and the sensitivity of grains of a given size can therefore be specified in a manner independent of such density measurements.

It does not appear necessary, therefore, to discuss their explanation of a discrepancy between experimental results and those theoretically expected, which discrepancy does not in our opinion exist.

We shall await publication of their experiments on removing adsorbed halide from silver bromide grains with interest, but prefer to postpone discussion of this until we have their fuller data.

E. P. WIGHTMAN
A. P. H. TRIVELLI
S. E. SHEPPARD

ROCHESTER, N. Y.

[1] See papers of Svedberg, *Phot. Journ.*, 62, 186, 316 (1923); Toy, *Phil. Mag.*, 44, 352 (1923); *ibid.*, 45, 715 (1923); Silberstein, *Phil. Mag.*, 44, 252, 955 (1923); *ibid.*, 45, 1062 (1923); S. E. Sheppard and E. P. Wightman on "The theory of photographic sensitivity," SCIENCE, 1923, pp. 89–91.

[2] *J. Franklin Inst.*, 194, 485 (1922); *J. Phys. Chem.*, 27, 141 (1923).

THE AMERICAN CHEMICAL SOCIETY

(Continued)

DIVISION OF ORGANIC CHEMISTRY

Frank C. Whitmore, *chairman*
R. R. Renshaw, *secretary*

The uses of acetylene in synthesis: J. A. NIEUWLAND. The evolution of acetylene in organic syntheses began with the introduction of catalytic agents to effect reactions. Some of the following important types of catalytic syntheses were discussed: A—The halogenation reactions, typified by (a) catalytic $AlCl_3$ reactions; (b) catalytic $SbCl_5$ reactions. B—Catalysis with mercury salts, as (a) acetaldehyde, glacial acetic acid and acetone; (b) paraldehyde synthesis; (c) synthesis of ethylidine diacetate, acetic anhydride, formaldehyde and methyl acetate; (d) synthesis of acetals and cyclic acetals; (e) synthesis of acetylene with aryl hydrocarbons; (f) synthesis of acetylene with phenols (bakelite), and the dinaphthylols; (g) synthesis with reacting substances in solution, aldehyde blue, and green, acridine and xanthene dyes. Quinaldine, indole, cinnamic aldehyde, nitro cinnamic aldehyde and indigo. C—Syntheses with Cu_2Cl_2, as (a) divinyl acetylene, and derivatives (HCHO); (b) quinaldine and quinoline de-

rivatives. General remarks on the possibilities of future progress in synthesis with C_2H_2 were made.

Synthesis of a new bicyclic nitrogen ring. Isogranatanine derivatives. Preparation of an isomer of homococaine: S. M. McElvain and Roger Adams. A method for the preparation of a derivative of a new bicyclic nucleus containing a nitrogen atom common to both rings has been developed. The new nucleus has been called isogranatanine because it is isomeric with granatanine. The particular derivative especially investigated was ethyl benzoyl isogranatoline carboxylate, prepared by reduction of the ethyl granatonine carboxylate and subsequent benzoylation. The ethyl benzoyl isogranatoline carboxylate hydrochloride is isomeric with homococaine hydrochloride, and is a powerful local anesthetic.

Recent developments in the chemistry of arsphenamine: Walter G. Christiansen. Arsphenamine, *i.e.*, salvarsan, as prepared by the customary process, *i.e.*, reduction of 3-nitro-4-hydroxyphenylarsonic acid with sodium hydrosulfite is not a pure substance, but contains at least three impurities—two sulfur compounds and one oxide. The amounts in which these impurities are present and the toxicity of the product are dependent upon the experimental conditions existing during the reduction. By the use of various modifications of these reactions, these impurities may be largely eliminated, but since a product which is satisfactory for clinical use can be secured by the above reaction, there is no necessity of abandoning this process. The colloidal properties of arsphenamine have an important bearing on the toxicity of this substance.

The electronic conception of valence and the heats of combustion of organic compounds: Morris S. Kharasch. The paper concerns itself with the application of the notions developed in a previous paper to the explanation of a number of properties of organic compounds. Considered in this light the study of the heats of combustion furnishes us with a very powerful tool for the determination of the electronic structure of organic compounds. The heats of combustion of some 275 organic compounds calculated upon this basis agree very well with the values that have been determined experimentally.

Petroleum as a chemical raw material: B. T. Brooks. Petroleum is sometimes referred to as a rich mixture of raw materials which should yield a wide variety of chemical derivatives comparable with the large number of substances which have been prepared or manufactured from coal tar. The problem of isolating pure substances from petroleum is, however, quite different and for the most part yet unsolved. Our present chemical knowledge of the hydrocarbons in petroleum enables us to make a certain limited survey of what might be expected in the way of a chemical development of this raw material. In this discussion the problem is considered more from the standpoint of research in organic chemistry than from the standpoint of the more or less well-known problems of the petroleum industry proper. The present discussion is limited more to an effort to indicate what organic chemists can reasonably expect to do with this raw material rather than to discuss any improvements or extensions in the application of petroleum products such as are now manufactured and utilized in the industries.

Wednesday—9:30 A. M.

Symposium on Synthetic Methods

The alkylation of primary amines with aluminum ethoxide to give pure secondary amines: W. A. Lazier and Homer Adkins. Both aromatic and aliphatic amines (aniline, p-toluidine, n-pentyl amine, n-butyl amine) have been alkylated with aluminum ethoxide, isopropoxide, normal butoxide and isobutoxide at temperatures of from 275°–350° to give secondary amines entirely uncontaminated with tertiary amines. The reaction of aluminum ethoxide and aniline has been most thoroughly investigated. A 90 per cent. yield of mono ethyl aniline has been obtained at 350° in a sealed tube, 10 per cent. of the aniline remaining unchanged.

Methylation by means of dimethyl sulfate: H. F. Lewis. Mass relationships have been studied in the methylations of the phenolic hydroxyl groups. Attempts have been made to develop a procedure for the utilization of the second methyl group in dimethyl sulfate. To a certain extent this has been accomplished.

Ethylation of aniline by means of diethyl sulfate: A. R. Cade. In the experimental work which forms the basis for this paper the reaction between diethyl sulfate and aniline has been studied. Varying mixtures of aniline, monoethylaniline and diethylaniline are prepared by varying the molecular ratio of the aniline and of the diethyl sulfate originally used in the reaction. The effect of the time and temperature of heating the reaction mixture has been studied. A method for preparing a high grade diethyl aniline, or a mixture of mono- and diethyl aniline free from unused aniline are recommended as a result of the data obtained.

The preparation of the simple olefine bromides: C. E. Boord. The bromine addition products of ethylene, propylene, butylene and amylene are easily and rapidly prepared in quantity by generating the olefine by the contact process and passing the gas counter-current to bromine or a solution of bromine in carbon tetrachloride in a special absorbing device. The products are purified by fractional distillation or if necessary fractional distillation under diminished pressure. Since the product is in contact with bromine for only a short length of time substitution is reduced to a minimum.

Modification of the Sandmyer synthesis of nitriles: H. T. Clarke and R. R. Read. The standard method for the preparation of nitriles from aromatic amines suffers from the disadvantage that poisonous gases are evolved at two stages in the process, namely, cyanogen during the formation of the cuprous cyanide and hydrocyanic acid during the reaction of this with the acid diazonium solution. It has been found possible to avoid both of these difficulties; firstly, by preparing the cuprous cyanide solution by dissolving cuprous chloride in sodium cyanide and, secondly, by neutralizing the diazonium solution before adding it to the cyanide. The intermediate addition products formed under these conditions are extremely unstable, rapidly evolving nitrogen below 0°, and decomposing almost explosively unless the mixture is well agitated, preferably in presence of a diluent such as benzene. The yields fully equal those obtained by the standard procedure.

Methods of manipulating liquid ammonia solutions: E. C. Franklin.

A new method of preparing alkyl halides: JAMES F. NORRIS. Primary alcohols are readily converted into the corresponding halides by heating the alcohol with concentrated hydrochloric acid and anhydrous zinc chloride. Proportions found to give the best results were one mol. of alcohol, two of hydrogen chloride as concentrated hydrochloric acid and two of anhydrous zinc chloride. The yields varied from 60 to 80 per cent.

Simplification of the Gattermann synthesis of hydroxy aldehydes: ROGER ADAMS and I. M. LEVINE. The Gattermann synthesis for the preparation of hydroxy aldehydes by the reaction of phenols, anhydrous hydrogen cyanide and dry hydrogen chloride in dry ether, sometimes with the addition of anhydrous zinc chloride, gives excellent yields of products. The method is not as frequently used as might be expected owing to the necessity of handling anhydrous hydrogen cyanide. The synthesis has been modified in such a way that this has been avoided. In place of the hydrogen cyanide, zinc cyanide is used, which is converted into anhydrous zinc chloride and anhydrous hydrogen cyanide in the reaction mixture. The zinc cyanide is readily prepared by treating an aqueous solution of sodium cyanide with magnesium chloride in order to precipitate the carbonate and hydroxide present, filtering and adding an alcoholic solution of zinc chloride. The precipitated zinc cyanide is filtered and dried. Experiments have shown that in several types of reactions anhydrous hydrogen cyanide has been previously employed, zinc cyanide may be substituted.

A new method for the synthesis of esters of chloroximino acids. Evidence of the existence of aliphatic diazonium salts: GLENN S. SKINNER. In attempting to obtain evidence of the existence of aliphatic diazonium salts by working at low temperatures, using esters of glycocoll in the presence of a large excess of hydrochloric acid, the esters of chloroximino acetic acid were found to be the chief product. These compounds by treatment with sodium carbonate give good yields of the corresponding nitrile oxides or their polymers. A comparatively small amount of the esters of chloracetic acid is also formed. The possibility that the chloracetic ester is first formed and then oxidized to the chloroximino ester has been eliminated by the fact that it remains unchanged when subjected to similar conditions. A second explanation of the reaction is that the diazo ester is first formed and this then reacts with the elements of nitrosyl chloride from the excess hydrochloric and nitrous acids present. However, the diazo ester was shown to give none of the substance when treated with nitrosyl chloride. A study of the molecular weight of the nitrile oxide in four different solvents shows that it is an equilibrium mixture of the monomolecular form and the dimolecular form the so-called furoxandicarboxylic ester. The yield of the chloroximino compounds varied from 50 to 80 per cent. of the theoretical. The reaction should be formulated as follows: $ClN_2CH_2CO_2R +$

$$HNO_2 \rightarrow ClN_2\overset{\overset{\displaystyle N=O}{|}}{\underset{\underset{\displaystyle H}{|}}{C}}\,CO_2R \rightarrow Cl-\overset{\overset{\displaystyle NOH}{\|}}{C}-CO_2R.$$

Condensation reaction: FRED W. UPSON. Certain points relative to carrying out the following reactions were discussed: (1) Reactions involving benzyl cyanide; (2) reactions between aniline and chlorohydrins; (3) addition of HCN to sugars.

Sodium amalgam as a reducing agent for oximes and aldehydes: L. CHAS. RAIFORD and E. P. CLARK. When sodium amalgam is prepared from pure mercury in accordance with the directions of the authors (J. Am. Chem. Soc., 45, 1740 [1923]) and used as specified, it is found to be a suitable agent for the reduction of certain oximes to the corresponding amines. Contrary to the results of Goldschmidt and Ernst (Ber., 23, 2740 [1890]), who found that only a poor yield of amine could be obtained by reduction of salicylaldoxime with sodium amalgam, although they tried several modifications of the method, we obtained a yield of 96 per cent. When salicyaldehyde was employed under similar conditions, with the exception that the liquid was kept faintly acid with acetic acid during the reaction, a yield of over 90 per cent. of the corresponding alcohol saligenin was obtained. The highest yield we have found reported in any other case is 63 per cent. Several other examples are being studied.

Tertiary butyl alcohol: ROLAND R. READ and F. A. PRISLEY. Isobutylene, prepared by the catalytic dehydration of the isobutyl alcohol, is passed into a light petroleum distillate kept at a temperature below $-10°$. The saturated solution is agitated vigorously with 50 per cent. sulfuric acid, the temperature being allowed to rise slowly to that of the room. The aqueous layer is separated and neutralized. Tertiary butyl alcohol is then distilled out and dried.

The use of phenyl-hydrazine for the preparation of some derivatives of benzo-pyrrol: E. C. KENDALL and A. E. OSTERBERG. The use of phenyl-hydrazine for the preparation of indol derivatives has long been known. Reduced benzo-pyrrol derivatives can be prepared by treating phenyl-hydrazones of cyclo-hexanone and its derivatives. To prepare members of the alpha-oxy-benzo-pyrrol series, the derivative of cyclo-hexanone must contain a side chain of two carbons terminating in a carboxyl adjacent to the ketone group, such as ortho-cyclo-hexanone acetic acid. If the hydrazone of ortho-cyclo-hexanone acetic acid is treated with acids, it will lose ammonia, producing a double bond within the ring, and will form the phenyl derivative of the open ring form of alpha-oxy-benzo-pyrrol. Derivatives in which a side chain is attached to the beta carbon of the benzo-pyrrol nucleus have also been prepared. The properties of these compounds depending upon the position occupied by the double bond will be discussed.

The oxidation of sucrose, glucose and fructose: C. D. LOOKER and W. L. EVANS. Sucrose and an equivalent mixture of equal parts of glucose and fructose were oxidized by means of potassium permanganate at 50°, 75° and 100° C. In neutral solutions, carbon dioxide and acetic acid were obtained upon complete oxidation. In potassium hydroxide solutions of varying concentrations at 50° and 75°, oxalic acid was also obtained and increased in quantity up to about 0.1 N alkalinity and

then decreased, but at 100° the amount of oxalic acid increased again beyond 1.0 N alkalinity. As oxalic acid increased, carbon dioxide always decreased proportionally. Acetic acid was nearly constant under all conditions.

Derivatives of the beta-chloro-vinyl arsines, II: W. LEE LEWIS and H. W. STIEGLER. In addition to previously reported derivatives, the following have been isolated in the pure state: beta-chloro-vinyl arsine sulphide; bis-beta-chloro-vinyl arsine sulphocyanate; tris-beta-chloro-vinyl methyl arsonium iodide; double salt of tris-beta-chloro-vinyl methyl arsonium iodide and mercuric iodide; double salts of tris-beta-chloro-vinyl arsine and silver nitrate with (a) 1 mole arsine and 1 mole $AgNO_3$ and (b) 2 moles arsine and 1 mole $AgNo_3$; double salt of tris-beta-chloro-vinyl methyl arsonium iodide and phenyl mercuric iodide.

Arsenoacetic acid and its polyarsenide: C. SHATTUCK PALMER. Hypophosphorous acid reduction of arsonoacetic acid, $H_2O_3As.CH_2.COOH$, leads to arsenoacetic acid, $HOOC.CH_2As = AsCH_2COOH$, yellow needles, which decompose above 200° but do not melt. The product is practically insoluble in water and common organic solvents, but readily soluble in pyridine and dilute aqueous alkali hydroxides and carbonates. Simultaneous reduction of one mol. As_2O_3 and two mols arsonoacetic acid gives the polyarsenide, $HOOC.CH_2.As = As - As = As.CH_2.COOH$, bright vermillion microcrystalline powder, resembling the simple arseno compound in solubilities and behavior on heating. The sodium salts of arsenoacetic acid and its polyarsenide are the first known water-soluble aliphatic derivatives of the arseno and polyarseno linkages.

The action of beta-chloro-ethyl chloroformate on amino-arylarsonic acids, and subsequent formation of arsonated N-arylamino alcohols. Preliminary Paper: CLIFF S. HAMILTON. The interaction of beta-chloro-ethyl chloroformate, prepared from ethylene chlorohydrin and phosgene, and amino-arylarsonic acids results in the formation of arsenated beta-chloro-ethyl carbanilates. These in turn give arsonated oxazolidones on treatment with alkali. The arsonated oxazolidones on further treatment with alkali yield, in some cases at least, arsonated N-arylamino alcohols.

The addition of mercuric salts to α, β-unsaturated ketones: EDMUND B. MIDDLETON. Unsaturated ketones reacted with alcoholic solutions of mercuric acetate. Ketones with one double bond like benzalacetophenone gave products whose composition is expressed by ketone plus $-HgOCOCH_3$ plus $-OR$, while dibenzalacetone gave products with two $-HgOCOCH_3$ and two $-OR$. They are α-acetoxymercuri-β-alkoxy ketones. If mercuric halides were used instead of mercuric acetate colored compounds consisting of one molecule each of ketone and mercuric halide resulted. The white products obtained with mercuric acetate gave reactions similar to those obtained from olefines: decomposition with acids, etc. With bromine, the mercury was replaced and α-bromo-β-alkoxy ketones resulted, for example, α-bromo-β-methoxy-β-phenyl propiophenone from benzalacetophenone. This lost HBr with alkali and the resulting unsaturated ketone reacted further with mercuric acetate to give diacetoxymercuri-dibenzoyl methane. On acidification, dibenzoyl methane was obtained.

The direct mercuration of benzine, and the preparation of mercury diphenyl: J. LEWIS MAYNARD. Direct mercuration offers the simplest method of obtaining derivatives of the type C_6H_5HgX. However, the method has heretofore been impracticable because of the very low yield of desired product. Since acetic acid formed in the reaction $C_6H_6 + Hg(OAc)_2 = C_6H_5HgOAc + HOAc$ apparently prevents more complete forward reaction, HgO was added to neutralize the HOAc as rapidly as it formed. Based on the quantity of $Hg(OAc)_2$ used, the theoretical yield of C_6H_5HgOAc was obtained by refluxing the three reactants for 55 hours. $Hg(C_6H_5)_2$ may be obtained from C_6H_5HgOAc by heating it under pressure to 140° with alkaline sodium stannite solution.

Unsymmetrical mercuri-organic derivatives and the nature of valences of mercury: MORRIS S. KHARASCH and MILDRED W. GRAFFLIN. The number of unsymmetrical mercuri-organic derivatives, of the type $RHgR_1$, recorded in the literature is limited to a few instances. The compounds are also claimed to be extraordinarily unstable and to decompose into two symmetrical molecules: $2\ R_1HgR \rightarrow R_1HgR_1 + RHgR$. The writers have evolved a method of preparing unsymmetrical mercury derivatives. Those prepared thus far are stable even at 200° and do not decompose into two symmetrical molecules. The decomposition of these molecules with acids should throw considerable light upon the nature of linkage of the mercury and the carbon atoms of the respective molecules.

The chemistry of furfural. The preparation of the furfural analog of benzoflavine or dimethyldiamino-furyl-acridine hydrochloride: S. A. MAHOOD and C. R. HARRIS. Furfural can be substituted for benzaldehyde to give condensation products with amines analogous to the derivatives of tri-phenyl-methane. When meta-phenylenediamine is used tetraamino-ditolyl-furylmethane is obtained. This yields, with hydrochloric acid under pressure, dihydro-diamino-dimethyl-furyl-acridine hydrochloride which on oxidation gives a new dye, the furfural analog of benzoflavine. It is typical acridine dye; gives to silk, wool and unmordated cotton a rich brown color and in fastness and stability is indistinguishable from its analog. Contrary to the work of O. Fisher but in accordance with that of Renshaw and Naylor, the substitution of the furyl for the phenyl group in dyes does not appear to render them less stable.

The polymorphic forms and thermotropic properties of Schiff's bases derived from 3-methoxy 4-hydroxy-5 iodo benzaldehyde: RAYMOND M. HANN. A review of the previous work on the effects of actinic light, trituration and heat upon the color changes of the parahydroxy anils. Discussion of the theories for explaining these physical changes bringing in mention of the Hantzsch Werner theory of molecular rearrangement, the molecular aggregation hypothesis and the possibility of stereoisomeric forms. Finally the effect of the introduction of a negative radical in the benzylidene group upon the polymorphic and thermotropic properties.

The ketenic decomposition of ketones: CHARLES D. HURD. Ketene was produced, not only from acetone, but also from methyl ethyl ketone and diethyl ketone when their vapors were passed through an electrically heated platinum coil in a partial vacuum. In addition, methyl ketene was obtained in small yields from methyl ethyl ketone and from diethyl ketone. High temperatures, apparently, decompose methyl ketene with the resultant production of ketene. Acetone and methyl ethyl ketone formed very small amounts of liquid condensation products. Much of the diethyl ketone, however, was changed to higher boiling material.

The addition of nitrogen trichloride to unsaturated hydrocarbons. II: G. H. COLEMAN and ELIZABETH PICKERING. Nitrogen trichloride adds to β-n-Amylene, α-n-amylene, and cyclohexene with the formation of C-chloro-N-dichloroamines. By the action of conc. HCl these amines are changed to C-mono-chloromines. The C-chloroamine obtained from β-N-amylene was reduced by sodium amalgam to the corresponding amyl amine.

Nitrophenols and nitrodiphenyl ethers: F. W. SULLIVAN, JR. 2, 4, 2′, 4′ tetranitrodiphenyl ether was obtained in 90 per cent. yield by the reaction between 2, 4 dinitrochlorbenzol and the potassium salt of 2, 4 dinitrophenol. On nitration with $NaNO_3$ in 50 per cent. fuming sulfuric acid, this yields 2, 4, 6, 2′, 4′ pentanitrodiphenyl ether, which melts at 205°. The constitution of this substance was proved because of its identity with the product obtained by the reaction between picryl chloride and the potassium salt of 2, 4 dinitrophenol. A small amount of a hexanitro compound melting at 258° is also obtained at the same time. This is believed to be the hitherto unknown anhydride of picric acid, but its constitution has not yet been proved. In connection with this work improved methods for the preparation of o-nitrophenol and 2, 6 dinitrophenol have been developed.

Derivatives of para-nitrobenzaldehyde: C. G. KING and ALEXANDER LOWY. p-Nitrobenzaldehyde was condensed with the following aromatic amines, forming "Schiff bases": o-nitroaniline, 2,6-dibromoaniline, 2,4,6-tribromoaniline, o-bromoaniline, m-bromoaniline, 3-bromo-4-toluidine, and p-xylidine. The first three would not condense satisfactorily in alcohol or glacial acetic acid, but did condense on direct fusion. Reduction of the nitro group on condensation products of the above type yielded unstable products. Dimolecular condensations were carried out with p-nitrobenzaldehyde and the following compounds: phenol (tetra-brominated and acetylated), resorcinol (dibrominated), thymol (dibrominated and benzoylated), o-nitrophenol and o-methyl anisol. In each case, bromination increased the depth of color. Oxidation of the phenolic products gave compounds analogous to the aurine dyes.

The electromotive force of organic compounds. II. The unsaturated hydrocarbon groups. S. B. ORENSON and D. J. BROWN. The observed potentials at 25°C. against the normal calomel electrode were $+0.09 - 0.03 \log (C_2H_4)(H+)$ for ethylene. Ethylene bromide and glycol seemed to have little or no effect on the observed potentials.

The composition of whale oil: C. H. MILLIGAN, C. A. KNUTH and A. S. RICHARDSON. The composition of whale oil has been studied by fractionally distilling the methyl esters of the solid, liquid and mixed fatty acids of the raw oil and also the methyl esters of the fatty acids of the hydrogenated oil. Whale oil, like other marine animal oils, contains a complicated mixture of fatty acids of carbon content varying from 14 to 22, probably with a small amount of C_{24} acids. The highly unsaturated acids are chiefly of 20 and 22 carbon content.

A contribution to our knowledge of orthoquinones: LEONARD T. CAPELL and C. E. BOORD. The substituted catechols were prepared by the action of potassium persulfate on para substituted phenols. The catechols were oxidized by the Willstatter method using dry silver oxide. The methyl, ethyl, terbutyl, teramyl and monochloro substituted derivative of o-benzoquinones were prepared. The absorption spectra of the green, red and yellow forms of these quinones were photographed and compared. All forms show the same absorption in dilute solution.

Basis for the physiological activity of certain onium compounds, III. Rates of Hydrolysis of esters and ethers of choline and of its analogs. Preliminary communication: R. R. RENSHAW and N. BACON. Dale has advanced the hypothesis that the extraordinary activity of acetyl choline and the evanescence of its action when compared with its ether and other esters may be due to the rapid hydrolysis of the former. The rates of hydrolysis of acetyl choline, the methyl ether of formocholine, acetyl formocholine and the acetyl derivative of the sulfur analog of formocholine have been studied at the temperature and hydrogen potential of blood. The preliminary experiment would seem to negative the suggestion of Dale.

The influence of high temperature on the decomposition of anthraquinone: H. F. LEWIS and SHERMAN SHAFFER. The action of dry heat and steam at atmospheric and elevated pressures has shown that there is a definite point beyond which anthraquinone begins to decompose rather rapidly. These upper temperature limits of stability approach 450 degrees with an air pressure of 35 pounds, 400 degrees with a steam pressure of 35 pounds, and 375 degrees with a pressure of 30 pounds of oxygen. A temperature of 500 degrees decomposes anthraquinone at such a rate that at the end of eight hours approximately 80 per cent. of the original anthraquinone has been decomposed. A study has been made of the decomposition products which shows that there are at least two new substances produced—one extremely stable and the other very unstable. The stable substance being of the nature of hydroxy-anthraquinone and the unstable substance indicating the condensation of two or more molecules of anthraquinone.

The action of acetylene on phenols: HERMAN WENZKE and J. A. NIEUWLAND. Acetylene in the presence of sulfuric acid and a mercury salt readily condenses with phenols to form ethylidene compounds. As in the case of ordinary phenol the position of linkage is usually para whenever that position is unoccupied. The tendency to form an aromatic acetal is slight, β-naphthol being the only compound tried that reacts in that way. The re-

action with acetylene continues even after the theoretical quantity of 1 mol. of acetylene to 2 mols of phenol has been absorbed. A tarry, resinous body is formed when an excess of phenol is absorbed. The presence of negative groups in the benzene ring as NO_2, SO_2OH, COOH prevented the reaction with acetylene. The phenol ethers, anisol and phenetol do not react with acetylene. Most of the condensation products polymerized on heating or on long standing to form an insoluble body.

Synthesis of aspartic acid: GLENN S. SKINNER and HARRY E. CARSWELL. A study of the conditions affecting the yield of aspartic acid has been made in its production from maleic and fumaric acids by the action of ammonia. The reaction has been carried out at temperatures of 100°, 109°, 117°, 125° and 137° for periods of time ranging from five to more than a hundred hours. The temperature range 110°–125° is most satisfactory. The optimum pH value for the precipitation of the aspartic acid was found to be 4.5. The conditions employed by Emil Fischer and by Engel were found to be unsatisfactory and it has been found possible to increase the yield to 70 per cent. of the theoretical. The melting point of the pure acid is 215°–217° in a closed tube.

The oxidation of sugars: FRED W. UPSON and M. H. POWER. Glucose has been oxidized by air in the presence of saturated lime water. The oxidation is slower than in the presence of more concentrated alkali as used by Nef but the products are qualitatively the same. Formic, d-arabonic, d-erythonic, glycollic, oxalic and carbonic acids are among the oxidation products. Experiments on the speed of oxidation of glucose and fructose in the presence of six equivalents of NaOH have been carried out. Glucose and fructose oxidize at practically the same rate. The rate is no faster with oxygen under two atmospheres pressure than it is with air at atmospheric pressure.

The oxidation of maltose in neutral and alkaline potassium permanganate solutions: W. L. EVANS and M. L. WOLFROM. Maltose is oxidized by neutral permanganate solutions at 50° to acetic and carbonic acids. In alkaline solutions oxalic acid is also an oxidation product in addition to acetic and carbonic acids. The oxalic acid production reaches a maximum at about 0.1 N alkali, while the carbon dioxide reaches a minimum at about this point. At higher alkalinities the oxalic acid diminishes in amount to a small degree while the carbon dioxide increases.

The oxidation of propylene glycol in potassium permanganate solutions: E. C. HYTREE and W. L. EVANS. When propylene glycol is oxidized in potassium permanganate solution at 0°, lactic acid is obtained as one of the oxidation products in addition to acetic and carbonic acids. Evidence was also obtained for the presence of lactide in the reaction mixture. From a consideration of the possible oxidation mechanisms it is highly probable that lactic aldehyde is an intermediate compound in the formation of lactic acid under these experimental conditions.

The relation between molecular structure and odor in tri-substituted benzenes. I. Derivatives of para-methoxy-acetophenone. M. T. BOGERT and L. P. CURTIN. Tri-substituted benzenes carrying three osmophores in 1:3:4 arrangement are not always odorous, even when sufficiently volatile. Although 4-methoxy-acetophenone itself is a perfume substance, the introduction of the osophores NO_2, NH_2, N_3 or CN, in position 3, results in odorless products. Certain new hypotheses are advanced concerning steric hindrance. The following new compounds are described:—the 3-sulfo, 3-amino, 3-acetamino, 3-p-nitrobenzal amino, 3-iodo, 3-iodochloride, 3-iodoso and 3-cyano derivatives of 4-methoxy-acetophenone; and from the 3-amino, the corresponding diazo perbromide, azido, diazoamino and aminoazó derivatives; also the 3-iodoso-4-hydroxy-acetophenone.

The synthesis of new rose alcohols of citronellol-rhodinol type: M. T. BOGERT and E. M. SLOCUM. Iodohydrin acetates were condensed with sodio acetoacetic ester at 0°, the products hydrolyzed to the keto alcohols, and the latter subjected to Barbier-Grignard reactions, the primary-tertiary glycols first formed losing water with production of the desired olefin alcohols. Dimethyl-hexenols,—heptenols,—octenols, etc., were thus obtained from acetopropanol, acetobutanol, etc. Some of these products have fine rose-like odor. The odor of others is more of cedar oil type. Various new intermediates were synthesized in the course of the investigation, and some old methods of preparation were improved so as to give greatly increased yields.

The decomposition of benzyl ethyl ether in air: RALPH C. HUSTON. Benzyl ethyl ether appears to be less stable in air than the simple dialkyl ethers, the aryl alkyl ethers or the diaryl ethers. Its decomposition apparently takes place according to the following scheme:

$$C_6H_5CH_2OCH_2CH_3 \xrightarrow{O} C_6H_5\overset{H}{\underset{OH}{C}}—OCH_2CH_3$$

$$C_6H_5\overset{H}{\underset{OH}{C}}—O—CH_2CH_3 = C_6H_5\overset{H}{C}{=}O + CH_3CH_2OH$$

The benzaldehyde formed is then further oxidized to benzoic acid:

$$C_6H_5\overset{H}{C}{=}O \xrightarrow{O} C_6H_5COOH$$

These changes take place when the pure ether (B. P. 185°) is allowed to stand for several weeks in an ordinary ground glass stoppered bottle. A small amount of the ether when placed on a watch glass and allowed to stand over night deposits crystals of benzoic acid. Benzyl alcohol is not oxidized under similar conditions. Since benzyl alcohol and acetaldehyde were not found in the decomposition products, it appears the CH_2 group between the oxygen and phenyl group is the main point of attack. The effect of other alkyl groups on the stability of the CH_2 between oxygen and phenyl group is being studied.

R. R. RENSHAW,
Secretary

SCIENCE NEWS

THE INTERIOR OF THE EARTH

Science Service

THE earth is built somewhat on the same principle as an old-fashioned metal-cored golf ball around which are wrapped several layers of lighter material ending in a thin surface crust. The metal core is pure iron or an alloy of that metal with nickel, according to a report to the Washington Academy of Sciences of Drs. E. D. Williamson and L. H. Adams, of the Carnegie Institution of Washington.

Discussing this report with a Science Service reporter, Dr. Adams said it was possible that the inmost core of the earth might be gold, or platinum, or other metals heavier than iron, but that it was practically certain that the center of the earth was an irregular sphere of iron about 4,200 miles in diameter. From the outer edge of this core, which is not sharply defined, to the surface is about 1,800 miles, and this distance is divided into three layers.

Next to the central iron core, Drs. Williamson and Adams relate, is a sort of mixed layer of iron and of rock, which extends with a gradually diminishing proportion of iron to within about 900 miles of the surface. Above this is a layer of rock, resembling that found at the surface but containing more magnesia and less silicates. Finally, there is the surface crust, about 35 miles thick, consisting essentially of the granitic rocks.

All this insight into the earth's anatomy is afforded through a study of the velocity of earthquake waves through the earth, mathematical considerations having to do with the mass of the earth as a whole, and a study of meteorites, whose average composition is believed to closely resemble that of the earth as a whole. For example, it is known that the density of the whole earth is about 5.52 times that of water, while the average density of the surface rocks is only 2.7. There must therefore be something heavier inside.

Pressure has something to do with that, as by squeezing the material of the rocks closer together it would make them denser, but the authors of the report state this would not be enough to cause such a great increase of density as is needed to explain the average density of the earth. The pressure at the center of the earth is calculated to be about 25,000 tons to the square inch.

A PORTABLE SEISMOMETER

Science Service

THE invention of a portable seismometer or earthquake measuring instrument, cheap, accurate and easily set up, was announced by Dr. Arthur L. Day, director of the Geophysical Laboratory of the Carnegie Institution of Washington, in a lecture before the institution on November 27. The new instrument will be used in a study to be made of earth movements in California. A specimen instrument exhibited at the lecture recorded the vibrations due to the movement of heavy trucks on the street outside.

The advance over the older type of seismometer made through the invention of this new type may be measured from the facts that the old type costs several thousand dollars, weighs tons and occupies a large amount of space, while the new instrument costs about $25 and may be quickly taken down and packed in an ordinary suitcase.

The principle of the new invention is the twisting effect of earth movements upon a piece of fine vertical wire to the middle of which is attached by one side a small weight. The ends of the wire are fastened to a framework which in turn rests upon a solid pier of masonry or other structure fastened securely to the earth's surface. Earthquakes move this framework while the attached weight remains still. This results in a twisting of the wire which is measured by the reflection of a beam of light from an attached mirror. A continuous record is possible by directing the beam of light upon a roll of photo-sensitive paper revolved by clockwork.

The apparatus itself seems extremely delicate to measure such a crude force as an earthquake. The wire is similar to the ordinary electric light wire filament and is about seven and a half inches long. The attached weight is a piece of copper about four fifths of an inch long and one tenth as thick, the mirror is about one sixth by one tenth of an inch.

Astonishing results have been obtained from the two of these little seismometers in use since last February in Pasadena, California. The Japanese earthquake was recorded in great detail from the beginning to the end. No little tremors in California go unrecorded. The device is sensitive to the passage of a street car at a distance of three quarters of a mile, while a railway train at a somewhat greater distance left a characteristic record.

Important practical applications are expected to follow the installation of numbers of these little instruments at different parts of California. It will easily be possible not only to record each quake, but to determine its direction and to track it to its lair. The machines may also be used for the recording of "artificial earthquakes" produced by the explosion in abandoned mines of left-over war explosives. Placed at varying and considerable distances from such explosions the record would be of great importance in determining little-known conditions in the deeper crust of the earth through which the waves would pass, conditions which might throw much light on the origin of quakes.

The instrument now in Pasadena accurately recorded a similar explosion 60 miles away last month when 115,000 pounds of blasting powder were set off at Palos Verdes.

Old fashioned seismometers or seismographs have been, because of their expense, rather a rarity in this country. With this new device it now becomes possible to set up a multitude of earthquake recording stations and to

SCIENCE

VOL. LVIII DECEMBER 14, 1923 No. 1511

CONTENTS

SCIENCE: A Weekly Journal devoted to the Advancement of Science, edited by J. McKeen Cattell and published every Friday by

THE SCIENCE PRESS

Lancaster, Pa. Garrison, N. Y.

New York City: Grand Central Terminal.

Annual Subscription, $6.00. Single Copies, 15 Cts.

SCIENCE is the official organ of the American Association for the Advancement of Science. Information regarding membership in the association may be secured from the office of the permanent secretary, in the Smithsonian Institution Building, Washington, D. C.

Entered as second-class matter July 18, 1923, at the Post Office at Lancaster, Pa., under the Act of March 3, 1879.

THE CONTRIBUTIONS OF PASTEUR TO MEDICINE AND HUMANITY[1]

IN his éloge of Littré, Pasteur, speaking of the Greeks, says these words: "Ce sont eux qui nous ont legué un des plus beaux mots de notre langue, le mot enthousiasme—un Dieu intérieur. La grandeur des actions humaines se mesure à l'inspiration qui les a fait naître. Heureux celui qui porte en soi un dieu. . . ."[2]

Enthusiasm—a God within! Happy indeed is he who bears this "God within"! The son of a tanner, a non-commissioned officer of the Armies of Napoleon, Pasteur was born at Dôle in the Franche Compté on 27 December, 1822. His first studies were at the Collège d'Arbois, whither his parents moved while he was yet a baby. In 1839, he entered the Lycée of Besançon, where he received his Baccalaureat ès arts. In 1842, he became Bachelier ès sciences. In the same year he entered the École normale supérieur, fifteenth out of a class of twenty-two. Dissatisfied with this rank he resigned and went to Paris to an institution directed by a compatriot in the impasse des Feuillantines. There he followed courses at the Lycée St. Louis and listened to the lectures of Dumas at the Sorbonne. At the end of the year, he was admitted fourth in rank to the École normale. Not remarkable as a student, he was classed seventh in his examinations for license, and third out of four candidates who were received at the Concours d'agrégation; and when he presented himself for his Doctorat, his two theses received but mediocre appreciation.

But this modest student bore a "God within" which led him on his way. That pathway was singularly straight and direct, for, as has been pointed out by many, the logical sequence throughout all Pasteur's work is striking and remarkable.

Beginning as a chemist he was led fatally into questions of general biology and thence to questions of pathology and therapy, animal and human. To the careless eye the way might seem winding and beset

[1] Address delivered at the Sorbonne on May 22, 1923, on the occasion of a meeting organized by the American Committee for the Commemoration of the Pasteur Centenary.

[2] "They have given us one of the most beautiful words of our language, the word enthusiasm—a God within. The grandeur of the acts of men is measured by the inspiration from which they spring. Happy is he who bears a God within!"

by digressions, but from the patient labors of his early days to the triumphs of his maturity each observation led so naturally to the other—from his earliest studies in crystallography to his work on rabies—that the story of Pasteur's contributions to humanity and medicine is the story of his scientific life.

EARLY STUDIES IN CRYSTALLOGRAPHY

In the course of his studies between 1848 and 1853, while repeating certain measurements of crystals of tartaric and paratartaric acid and their salts which had been made by Provostaye, he observed that the crystals of the tartrates bore hemihedral facets like those of quartz; the crystals were dissymmetrical, the facets occurring only on the right side; solutions rotated polarized light to the right. Crystals of the paratartrates, on the other hand, although chemically identical, bore like facets *symmetrically arranged on both sides; their solutions were optically inactive.* This led Pasteur to fancy that a relation might exist between the asymmetry of the crystals and the optical activity of their solutions—a relation like that between the asymmetrical crystals of quartz and the optical activity of blocks cut from them.

Struck by a statement of Mitscherlich that one of the salts of paratartaric acid gave rise to asymmetrical crystals similar to those of the corresponding tartrates, Pasteur discovered that, in reality, when this salt was crystallized it resolved itself into two groups of dissimilar, asymmetrical crystals of tartaric acid, which were reciprocally symmetrical; that is, each was as the image of the other in a mirror. The one group bore hemihedral facets on the right, the other, which was new to science, on the left. Solutions of the one deviated polarized light to the right, of the other, to the left.

The rotatory power residing in solutions of these crystals, Pasteur ascribed to like dissymmetry in the atomic structure of the molecules.

In this fruitful hypothesis as to molecular structure lay *the germ of the theory of stereo-chemistry.*

More than this, Pasteur observed that in fermentation of solutions of paratartaric acid, associated with the growth of a common mould (*Penicilium glaucum*) the organism, in its development, consumed the dextro-rotatory component of the salt, thus changing an optically inert solution of paratartrates to a laevo-rotatory solution of tartrates.

Considering, in connection with these studies, the optically active character of the principal constituents of living bodies, such as the albumens, the celluloses and the sugars, Pasteur conceived the importance of molecular dissymmetry in the phenomenon of life.

In these initial studies Pasteur one day broke a piece from an octahedral crystal and dropped the injured crystal again into its mother liquid. With the renewed growth of the crystal a special activity was evident at the injured spot; in several hours the crystal had assumed its original form. And Pasteur, whose active mind always cast about for the ultimate significance of his observations and discoveries, called attention to the circumstance that the cicatrization and repair of wounds might well be compared with this physical process.

In 1849 Pasteur was made professor of physics in the University of Strasbourg. There in the same year, he married Marie Laurent, daughter of the rector of the university—a noble woman who throughout his life was his patient and devoted companion and helpmate, his assistant, his adviser, his inspiration.

FERMENTATIONS

Later, in 1854, when professor and dean of the faculty of sciences in Lille, the father of one of his pupils laid before him certain difficulties in the making of alcohol from beets and Pasteur began the study of fermentations. Here from the beginning it was his earlier experiences that guided him on the way.

The growth of yeasts in association with fermentation had been known and discussed from the days of Leeuwenhoeck in 1689, but despite the observations of Schwann and Cagriard-Latour, purely chemical and physical explanations still reigned. Fermentation, according to the prevailing ideas of the day (Liebig), depended on the breaking down of the molecule by decay and disintegration, set in motion by the presence of some dead nitrogenous material. Pasteur's observations had shown him that, excepting in the presence of a living substance, molecular dissymmetry, which renders a body optically active, disappears with the breaking up of the original molecule. On the basis of his experience he was convinced that a dissymmetrical disposition of the elementary atoms of the molecule on which optical activity depended, could be created only through the intervention of some vital process. That vital process was the growth of a yeast.

In the fermentation of potato amyl alcohol is produced which is laevo-rotatory; but the molecular constitution of the amyl alcohol is too far removed from that of the sugar from which it is derived to retain the molecular dissymmetry and the optical activity of the sugar molecule. In the creation of such a substance some vital process must have intervened. The question of lactic acid fermentation was especially intriguing to Pasteur because Liebig had asserted that here no yeast was present. But Pasteur showed clearly that this fermentation was dependent upon a living organism, a bacillus, so small that its presence

had escaped the notice of others. The organism was the ferment. At first he called it a yeast, so unimportant to him was its form. As Delezenne has said, "*It is not in form, it is above all in functional aptitudes* that Pasteur found the proof of the specificity of micro-organisms. For the first time morphology made way for physiology in the definition of species."[3] He showed that the ferment reproduced itself, and at the very beginning he asserted: "The purity of a ferment, its homogeneity, its free development without interference, with the aid of a nutrient medium adapted to its individual character, this is one of the essential conditions for good fermentations." And again: "If, in the saccharine, albuminous, clear solution one sow the yeast of beer rather than that of lactic acid, it is the yeast of beer that will develop and with it alcoholic fermentation, although there be no change in the other conditions of procedure. One must not infer from this that the chemical constitution of the two yeasts will be identical any more than that the chemical constitution of two vegetables is the same because they have lived on the same soil." In other words, he pointed out the specificity of these organisms and their specific physiological action. Finally, in an experiment of great beauty and simplicity he demonstrated the growth of micro-organisms with fermentation in a liquid free from organic nitrogenous matter.

"Alcohol fermentation," said he, "is an act related to life, with the organization of the globules (yeast), not with death or the putrefaction of these globules."

In connection with these studies he pointed out that, "Each cell of yeast has properties of species and of race which it shares with the neighboring cells, and, moreover, special characteristics of its own which it may transmit to its progeny." Thus he called attention to variations of species, and in the end gave to the manufacturers of beer the precious principle of the selection of yeasts.

In 1859 he was nominated administrator of the École normale and assistant director of scientific studies.

The development of a method designed to secure pure cultures from fluid media, the use of culture media of known composition, and the careful chemical study of products of decomposition all belong to this early period of Pasteur's life and were achievements of the deepest significance. . . .[4]

BUTYRIC ACID FERMENTATION—ANAEROBES

Upon these studies followed naturally the demonstration of the dependence of butyric acid fermentation on an organism which could develop only in the absence of free oxygen—the discovery of anaërobes. He showed how, in a fluid medium, the action of anaërobes follows that of the aërobes which use up *the oxygen* and by *the film* which they *form on the* surface of the liquids prevent its further entrance, thus preparing the way for the anaerobes in the depths.

SPONTANEOUS GENERATION

Then, naturally (1860–1876), came the famous studies on spontaneous generation undertaken against the advice of his doubting masters, Biot and Dumas. On the basis of careful and well-conceived experiments he demonstrated the universal presence of bacteria in air, water, dust; he showed the variations in different regions of the bacterial content of the air; he demonstrated the permanent sterility of media protected from contamination, and he insisted on the inevitable derivation of every living organism from one of its kind. "No," he said, "there is no circumstance known to-day which justifies us in affirming that microscopic organisms have come into the world without germs, without parents like themselves. Those who make this assertion have been the playthings of illusions or ill-made experiments invalidated by errors which they have not been able to appreciate or to avoid." In the course of these experiments he demonstrated the necessity of reliable methods of sterilization for instruments or culture media, of exposure for half an hour to moist heat at 120° or to dry air at 180°. And behold! our modern procedures of sterilization and the basis of antiseptic surgery.

STUDIES ON VINEGAR

Then came the studies on vinegar, undertaken in an attempt to relieve the embarrassment of an important national industry, and the demonstration that the formation of vinegar was a process of oxidation and dependent upon the development of micro-organism, *Mycoderma aceti*, which forms a pellicle on the surface of the liquid and serves as a conveyor of oxygen from the air without to the alcohol within, from which it gains its sustenance. He resolved simply and practically all the important questions at issue in connection with the protection of the manufacturers of vinegar. In the course of his studies he showed that in the absence of alcohol, its diet of choice, *Mycoderma*, might go farther and attack and disintegrate the acetic acid, the product of its own creation. This not only explained certain annoying phenomena associated with vinegar production, but was the first demonstration of the ability of a living organism to destroy the product of its own development.

It is most interesting to note, by the way, that in

[3] 100th Anniversary of the Birth of Pasteur, Bulletin de l'Academie de médicine, 3, series, tome LXXXVIII.

[4] Herter, Johns Hopkins Hosp. Bull., 1903, XIV, 325.

studying enfeebled, "diseased" *mycoderma*, as he called it, he likened the oxidizing activity of the micro-organisms to that of the red corpuscles of the blood whose function it is to carry oxygen to the tissues, and asked himself what might happen in the human body if the diseased red blood corpuscles were inadequate to their task of oxidation.

Fascinating and interesting it is to see how, all along the way, his fertile, active mind sought the parallels between his observations and the diseases and injuries of man.

Certain manufacturers had taken advantage of his previous work and had secured patents for their own interest. To prevent the repetition of such a procedure before announcing a "new industrial procedure for the fabrication of vinegar" he took out a patent himself, and threw it open to the public.

Diseases of Wine

Then he passed to the studies of the diseases of wines (1865) which he found once more to be due to the development of living organisms. It was easy to prevent their development by sterilization, but how could this be done without destroying the wine? In the end he showed how the further development of the bacteria could be inhibited by rapid heating to 55° in closed vessels, at the proper period, and we have the process of "*Pasteurization!*"

Diseases of the Silkworm

The silkworm industry, so vital for France, was in sore distress. An epidemic disease increasing in severity was ruining the population of the south, who appealed to the government. Pasteur, a chemist, who knew nothing of the silkworm or its diseases, was requested to undertake the investigations into the nature of the disease and measures for its prevention. For six years, from 1865 to 1871, he gave his whole time to this work.

The silkworms, raised from the egg by exposure to gentle heat at the moment when the first leaves of the mulberry tree are opening, are covered immediately by young leaves upon which they feed. The worms seem to sleep as they clothe themselves with one skin after another from which, in succession, they moult. After the fourth moult, they pass through several days of extreme activity and voracity, following which they climb upon sprigs of heather carefully set out for them and form their cocoons. In the cocoons they remain for fifteen days. After this the moths emerge, sex-union occurs, and six hundred to eight hundred eggs are laid by each worm. If it be decided to use the cocoon for the manufacture of silk they are smothered in a vapor bath six or seven days after the worm has ascended the heather twigs. If, however, it be desired to collect eggs for the next brood, the emergence of the moth is awaited. When a brood appears especially good, through the regular development of its worms and the beauty of the cocoon, it is saved for its eggs.

For twenty years this disease had existed, and despite the importation of eggs from foreign countries, it had become worse and worse; it was known as Pebrine because of little, black, pepper-like spots which developed upon the diseased worms. In the diseased worms and in the eggs there had been found small, round corpuscles (psorosperms) which were regarded as evidence of the disease, and Osimo of Padua had already suggested that eggs should be saved for cultivation only from worms which did not contain corpuscles. But this measure had not been carried out with any regularity, and the true nature of the disease remained unknown.

In two years Pasteur solved the main problem. Although slow at first to recognize the infectious nature of the "corpuscles," he finally demonstrated that they were the infectious agents, that they might be introduced through the gastro-intestinal tract from leaves soiled by diseased worms; that they were hereditarily transmitted through infected eggs. He saw that the secret of protection lay in the microscopical examination of the moths at the time of their emergence from the cocoon, and that where more than 10 per cent. of these moths were "corpuscular," the eggs should not be used. By maintaining the cocoons at a temperature of 25° to 30° R, the emergence of the moths was hastened by five days. Test cocoons were submitted to high temperatures and where the number of diseased moths was too great, the attempt to collect the eggs was abandoned and the entire brood was used for the cocoon.

But this was not the whole story. Although, under these methods, the recovery of the silk industry seemed to be promised, yet there were puzzling circumstances. Sometimes the disease seemed to precede the appearance of the corpuscles; this might indeed occur in experimental infection of the worms. One day, with a despairing gesture, Pasteur announced to his colleagues that they must begin again; there were two diseases!

But in due time he solved the problem of the other disease, a sort of typhoid or cholera of the silkworm due to organisms widespread in nature. This malady was generally transmitted from worm to worm through the sticky excrement shed by diseased animals upon the leaves upon which they fed. *Flacherie* as it was called, occurred alongside of *Pebrine* and had thus caused considerable confusion. Flacherie also was an hereditary disease.

With this knowledge the necessary prophylactic measures were soon devised. Pasteur had but to add to his former directions: "One should never use for

eggs broods which have shown from the fourth moult to the cocoon, any languishing worms, or which have shown definite evidences of flacherie," and the silkworm industry was saved.

In the course of these studies Pasteur made observations of great interest. He found, for instance, that the period of incubation of the disease varied according to different circumstances; that when the infectious agent was carried from worm to worm through a series, the period of incubation was shortened. Repeated passages of the parasite through successive hosts increased its virulence.

He noted the difference between the period of incubation in worms infected by means of hypodermic injections and those acquiring the disease in the usual manner—*the influence on the period of incubation of the portal of entry:* he recognized that although the infectious agent was widespread, almost always present, the disease did not always arise; some worms seemed to resist infection—in other words, there were *variations in resistance and susceptibility of the host.*

As Duclaux says, he had brought the great questions of contagion and heredity into the field of experiment.

At about this time, the study of a mould, *Mucor mucedo,* led him to appreciate the *possibility of the anaërobic life of aërobic species and the variations in form of an organism which may accompany the variations of the media in which it lives.*

He then returned to his studies of wine, led by the desire to discover whence came the organisms which caused the alcoholic fermentation of grapes. By simple but ingeniously devised experiments, he showed that these organisms, *Saccharomyces,* were widely distributed and were to be found on the surface of the individual grapes. But they appeared only at a definite time in the development of the grape, at a fixed season of the year. On the other hand, the *mucor* parasites capable also of producing a fermentation were present at all times in the soil.

And his alert mind, ever seeking analogies between these processes in the vegetable kingdom and human disease, led him to these prophetic reflections:

> May we not, by analogy, be justified in the belief that one day simple and easily applied measures of prevention will arrest these scourges which at one blow desolate and terrify whole populations such as the terrible disease (yellow fever) which has recently invaded Senegal and the Valley of the Mississippi, or that other (bubonic plague), more terrible perhaps, which has raged on the banks of the Volga?

In 1874 there came to Pasteur from Edinburgh a grateful and appreciative letter from Joseph Lister, who called attention to the beneficent results which had followed the application of his principles, scrupulous cleanliness, antisepsis, to the practise of surgery.

An era had passed—the old black era of helplessness and uncertainty, of cruel doubt and hope deceived. The hand of the surgeon was freed.

Anthrax

While the old controversies concerning fermentations and spontaneous generation still continued, the victory was already won, and more and more Pasteur's mind turned towards the practical application of his discoveries to diseases of higher animals and man. For this, as Duclaux has so clearly pointed out, he was well prepared. His demonstration of the specificity of micro-organisms, his observations on their life history, and especially of their nutritive demands, his studies concerning the increase and diminution of virulence, of the variation, under different conditions, of the resistance of the host to infection—all these observations and conceptions had taken root in his mind and it is but natural that he should have turned to the study of infectious diseases in the higher animals.

In 1877, he began the study of anthrax—a cruel disease, fatal to sheep and cattle, especially the former. Sometimes nearly half a flock died in one season. There were special regions which seemed fatal, fields or hillsides on which sheep might not feed, over which they might not pass without acquiring the disease. To what was this due? For many years (Delafond, 1838) the existence of little rodlets in the blood of animals dead of anthrax had been known and the question as to the infectious nature of these rodlets had been raised (Davaine, 1850). Pasteur had discovered resistant spores in the bacillus of Flacherie, structures destined to preserve the life of the organism through long periods under adverse conditions. Koch, but a year before, had pointed out like spores in the bacillus of anthrax. More than this, Koch had cultivated the bacilli in the aqueous humor of the eye and in fresh drops of the blood serum of the ox. These cultures he had carried through eight generations, and from them he had transmitted the disease to small animals. But some objectors still raised the question as to whether he might not have carried over some vague virus from one to another of these small cultures.

Pasteur cultivated the bacillus in flasks containing fifty cc of neutral or slightly alkaline urine and succeeded in carrying on these cultures indefinitely from generation to generation. The tenth generation was as capable of transferring the disease as the first. Here one could hardly imagine the transference of a virus other than the bacterium. Fowls were refractory to the disease.

Gas Gangrene

During Pasteur's studies concerning the specificity

of the bacillus of anthrax, other observers in carrying out inoculations from animals dead with the disease had produced a fatal illness without the presence of the bacteridia. Pasteur discovered in the blood of these animals another organism, a long bacillus, found normally in great numbers in the intestinal tract, which, after death, might enter the blood and develop more rapidly than does the organism of anthrax. When both organisms were introduced at the same time the animal died from septicaemia due to the multiplication of the other bacteridium which he called *Vibrio septique,* before *Bacillus anthracis* had time to grow. The new organism, closely allied to the so-called gas bacillus of Welch, was anaërobic and produced gas in the tissues of the animal infected—the familiar gas gangrene.

In a communication to the Academy of Medicine made on April 30, 1878, Pasteur points out the danger of the entry of such organisms into the tissues, their relation to surgical gangrene, and insists on the importance of antisepsis in surgery. These are his closing words:

> A few weeks ago one of the members of the section on medicine and surgery of the Academy of Sciences, M. M. Sédilot, after having meditated long on that which he had learned in a brilliant career, found a rational explanation in the principles on which rest the so-called germ theory, and that this would give rise to a new surgery, already inaugurated by a celebrated English surgeon, Dr. Lister, who, one of the first, had comprehended its fecundity. Without professional competency, but with the conviction of the qualified experimenter, I shall dare here to repeat the words of our eminent confrère.

These were busy days in which Pasteur's vision, penetrating into many vistas, was constantly making fresh observations and new discoveries.

Fowls he had found resistant to anthrax. But the organism of anthrax is readily killed at high temperatures, and the ordinary temperature of a hen is 43° or 44° C. If the lower third of the body of a fowl be held immersed in water at 25°, the body temperature may be lowered to that of man or those animals susceptible to anthrax. But introduced into a hen with lowered temperature, the bacillus throve and multiplied, and the fowl died.

STAPHYLOCOCCI AND STREPTOCOCCI

New observations succeeded one another in rapid succession. In 1879, Pasteur discovered in abscesses of the skin little round organisms which grew in clumps like bunches of grapes, whence the name, Staphylococci, and later he found the same organisms in an instance of osteo-myelitis, which, forthwith and quite properly, he called an "abscess of the bone-marrow."

In the *maternité* he found similar round organisms, arranged, however, in chains (Streptococci) in the lochia of women with puerperal fever and in the diseased tissues of those who had died, and he suspected immediately that this organism was the cause of the disease.

At a meeting of the Academy in a discussion on puerperal fever, Pasteur, impatient, interrupted the speaker. "That has nothing to do with the cause of the epidemic; it is the doctor and his personnel who carry the germs from a diseased to a healthy woman." And when the orator replied that he doubted whether such an organism would ever be seen, Pasteur dashed to the blackboard and figuring a chain of streptococci, exclaimed, "There, behold its picture."

In 1806 at the *maternité* one woman in four died of infection; to-day at the Baudeloque (Calmette) the mortality is one in two thousand.

In the words of Descour, "Thanks to Pasteur, maternity hosiptals are no longer ante-chambers of death."

CHICKEN CHOLERA—VACCINATION

Next, Pasteur took up the study of a disease of poultry, chicken cholera, a disastrous epidemic malady which played havoc in the poultry yards. A parasite had been discovered by others and suspected of being the cause of the disease. Toussaint had shown that the disease could be transmitted by the blood of the diseased chicken; but he had failed in his efforts to cultivate the germ. He sent Pasteur the head of a cock dead of chicken cholera. Pasteur found the small bacillus which failed to grow in ordinary media but developed rapidly upon that which his insight soon suggested, a broth made of the muscles of the chicken itself. The infectious agent entered by the gastro-intestinal tract, passed out through the excrement and was thus scattered about the poultry yards.

In guinea pigs the organisms of chicken cholera produced only local abscesses, but retained their virulence; and Pasteur pointed out how such infected pigs might, through discharging abscesses, spread the disease—the first example of carriers.

One day, after a vacation, he inoculated some fowls with an old culture which had stood, untouched, for some weeks; the birds were but slightly ill—and recovered. What had happened? He inoculated the same fowls with fresh cultures; they remained unaffected. But fresh fowls, inoculated for the first time with these same cultures, died in the usual manner. The old cultures had lost their strength. *Inoculation with these old, attenuated cultures had conferred immunity!* Pasteur had made his greatest discovery, that of the possibility of preventive vaccination!

It was no mere accident. To his prepared mind the experiment had immediately suggested itself. The

analogy with Jenner's vaccination against smallpox was instantly grasped—an analogy in a disease known to be due to a micro-organism! The attenuation of the virulence of the cultures depended on their age. According to the age of the cultures, every degree of attenuation could be obtained. The characteristics of each generation of cultures were hereditary and fixed. Pasteur, as Roux has said, obtained races of virus as gardeners obtained races of flowers.

It was not so much that a method of preventing a disastrous disease of poultry yards had been found; the door had been opened.

Pasteur had meditated and speculated on many possibilities. Among other things he had noted that in certain cases, instead of killing rapidly, chicken cholera passes into a chronic state, the fowls succumbing only after weeks and months of languor. But when the parasite is grown from these birds, its virulence, contrary to what one might expect, is exalted to a maximal degree. And he observed that this interesting example of the combat between host and parasite found an analogy in those instances of rabies with long periods of incubation. Rabies already was in his mind. He was ever reaching for analogies. Among his papers of this period is a project for the study of plague such as that later and so fruitfully carried out by his pupil, Yersin.

PROPHYLAXIS OF ANTHRAX

At the same time Pasteur was still pondering upon the subject of anthrax. The neighborhood of a pit in which diseased animals were buried was notably dangerous. He had demonstrated living spores on the surface of the earth as long as twelve years after burial of the animals. How could these spores on the surface of the earth stand the dispersing influences of wind and rain? Where did they come from? Could it be that they arose from the depths? If so, how?

One day while walking in such a field freshly harvested, he noticed certain spots which differed from others in colour. These were the areas in which diseased animals had been buried. He examined them closely. The soil was thickly covered with the castings of earth worms; and the truth flashed upon him. It was the earth worm in its silent labor of aëration and drainage of the soil, burrowing to the depths and bringing again to the surface those particles which it deposits in its little spiral castings, it was the earth worm that brought to the surface again the spores of anthrax. He demonstrated spores in worms and in castings—and straightway an important measure of prophylaxis became apparent, namely, that diseased animals, if they could not be disposed of otherwise, should be buried only in dry, barren, sandy soil.

VACCINATION AGAINST ANTHRAX

The minister of agriculture demanded that Pasteur investigate a method of treatment of anthrax introduced by a veterinarian in the Jura. In the course of this study he was given two cows which had recovered from the disease. They resisted inoculation with virulent cultures. They were immune. Vaccination was possible. But how produce the vaccine? The spore-producing characteristics of the anthrax bacillus rendered this procedure difficult and puzzling. The organism does not grow at temperatures above 44°. Between 42° and 43°, however, the spores are no longer formed. If cultures are kept at this temperature for about a month, the time comes when they cease to grow on transference. With the age of the culture, virulence for sheep, rabbits and guinea pigs diminishes rapidly and progressively until it disappears. The characteristics of the organism at each age are stable, but the virulence may be raised immediately by passing them again through successive living subjects, beginning with the young, which are most susceptible, and passing the organisms through successively older animals. The analogy with the bacillus of chicken cholera was complete. Might not the cause of some spontaneous epidemics be the reëstablishment of virulence in an organism which had reached a degree of attenuation so great as to be almost if not quite innocuous?

It was but a step to vaccination against anthrax with attenuated cultures. And when he was ready, the efficiency of the measure was demonstrated in dramatic fashion. Before a large audience, fifty sheep were inoculated with a highly virulent culture of anthrax. Twenty-five of these sheep had previously been vaccinated with attenuated cultures. The non-vaccinated sheep all died; the vaccinated all recovered. A reliable measure of prophylaxis against anthrax had been established.

SWINE FEVER

In March, 1882, Thuillier, at Pasteur's request, began the study of swine fever, a fatal and widespread disease. The pathogenic organism, a small bacillus, was soon isolated. Pasteur remembered his observations on the organism of rabbit septicæmia which he had found a year or so before in the saliva of a child with rabies. Although harmless for old guinea pigs, this organism was virulent for the young. Passed through a series of young animals, the virulence was so far raised that it became pathogenic for the old as well. But he had made this striking observation: *In the course of its passage through guinea pigs the organism had lost its virulence for rabbits.* In these regions where swine fever pre-

vailed, epidemics were frequent among pigeons and rabbits. The bacillus of swine fever killed pigeons rapidly and by passing the organism through a series of pigeons, its virulence, both for pigeons and for swine, could be raised to a degree considerably above that attained by strains carried alone from hog to hog. The same bacillus killed rabbits, but, although on successive passages through rabbits its virulence was augmented for them, the virulence for swine became progressively diminished, so that in the end an attenuated organism was obtained—capable of transmitting to swine a mild disease only, from which they recovered with an immunity lasting at least a year. A method of vaccination was at hand. Swine fever in its turn was conquered.

Rabies

That the mystery and the hopelessness of rabies had long been in Pasteur's mind is clear from the occasional references to the disease that appear in his earlier studies.

In 1880 the opportunity came to observe a patient in the wards of Lannelongue. From the sputa, as has been mentioned, he had obtained the bacterium of rabbit septicaemia which later turned out to be the pneumococcus of Fraenkel. All further attempts to cultivate a pathogenic organism failed. By introducing subcutaneously bits of the central nervous system, he had transferred the disease, but the period of incubation was distressingly long and uncertain, amounting sometimes to months.

Finally, by introducing bits of the substance of the medulla of affected animals under the dura mater of the brain, he succeeded in transmitting the disease with certainty, with an average incubation period of about fourteen days.

And then, guided by his experience with other organisms, which he had studied, he succeeded, by repeated passage from rabbit to rabbit, in obtaining a virus of great strength and of an incubation period of a maximum of seven days.

By passage through monkeys the virus could be attenuated to such a degree as to be nearly harmless on subdural introduction into the dog. *These injections conferred immunity.*

He reflected on the long incubation period following the bite and the short period which elapsed between the inoculation and the outbreak of the disease when the strong virus from rabbits was used. Might one not, by subjecting the cords of these rabbits to the action of oxygen in dry air, produce an attenuated virus which would yield a safe vaccine? And with such a vaccine with a short period of incubation, might one not hope, even after the patient was bitten, to produce immunity against the more slowly developing virus introduced by the bite?

Cords of rabbits dead with malignant rabies of an incubation of seven days were subjected to the action of oxygen in jars containing a little caustic potash. Attenuation was readily obtained.[5] By subcutaneous injection daily of bits of these cords of progressively increasing virulence, it was possible to immunize dogs to the most virulent material even if introduced under the membranes of the brain.

At this point in his studies there was brought to his laboratory a little Alsatian boy who, sixty hours before, had been terribly bitten by an obviously mad dog—bitten in such a manner that the development of the disease seemed certain.

Pasteur took counsel with his friends, and acted. He suffered, in silence, cruel anxiety. In nine days the little boy had finished his treatment and had received, finally, injections of the most virulent material, material tested step by step on control animals. The boy was saved. Others followed. The almost universal success of the treatment if begun early, was proven beyond a peradventure.

In 36 years, out of nearly 45,000 patients brought to the laboratory at various periods after the bite, the mortality had been but three per thousand.

The name of the master and the fame of his accomplishments were on the lips of all the world. Honors poured upon him. National subscription built the Institute, that Institute of which he has said: "There is not a stone which is not the material evidence of a generous thought," and there and in all lands thousands of his disciples continue the work that he initiated.

This, in brief, is the story of Pasteur's contributions to medicine.

And the man?

An artistic nature, gifted with powers of design that, early in life, seemed to point to another career.

A sensitive, poetic spirit which betrays itself again and again in the charm of his language. But the emotions of the artist and the poet were controlled by an overpowering love of truth and the censorship, in matters of science, of a Puritan conscience.

He was a noble example of the disinterested student. When asked by the emperor why he sought no material advantage from his discoveries he replied: "In France men of science would consider such an act unworthy."

He was intensely human—human, if one may say so, in his very humanity, for with all his love of pure science, he was forever asking himself how he might use his achievements for the benefit of his country and his fellows; human in his tender-heartedness and gentleness and love for animals; human in his impatience toward opposition, for he was not always patient

[5] In the sense, possibly, only of a diminution in the *number* of organisms.

under criticism, especially if that criticism were born of prejudice or supported by careless or ill-formulated experiments or observation—against such opposition his polemics were sharp; nor in hours of work was he especially tolerant of those futile interruptions which are the despair of the student; human in his devotion to his parents and to his family, and in his profound patriotism.

From the foundation of the institute to the day of his death, in 1895, his quiet life among his friends and his students in the laboratory was a long triumph. As it has been said of Jeanne d'Arc, so was it true of Pasteur—he had become a legend while yet he lived.

Early in his career he had risen again from a physical blow that too often saps the vigour and initiative of the strongest. The "God within" carried him forward and onward over obstacles and through trials that would have baffled another.

Now, he was tired. The loving homage of grateful humanity was almost a burden. But he lived to see the first of the harvest, and he died with the world at his feet.

In the 40 years of his active life Pasteur laid the basis of our knowledge of infections and infectious agents from which such inestimable blessings have flowed; he "revivified the biological sciences" (Herter), but more than this, as Widal has well said, he introduced into medicine accuracy and precision of technique and the habit of experimentation—"the *realization of the necessity of precision and the means* of satisfying it."

From the seed that he sowed, what a harvest has come forth! Improvements of technique introduced even during his life time have brought increasing certainty and accuracy into our methods. One after another the plagues of humanity are yielding their secrets to inquiring students. The questions of immunity and susceptibility on which he had but begun to ponder have expanded into profound and complicated problems which for their explanations are turning us more and more back to the fundamental chemical and physical principles with which he began.

The scope of preventive medicine, which, one might almost say, began with Jenner and Pasteur, has widened until problems of public hygiene have become, throughout the world, matters of civic, national, international concern.

And finally, as Calmette has said:

Dans l'ordre social l'oeuvre de Pasteur n'a pas été moins féconde. En nous faisant connaître la cause des maladies, en nous montrant que ces causes sont justiciables de notre intervention, elle a complètement modifié les anciennes conceptions du devoir social vis-à-vis des malades.

Cet ensemble de notions nouvelles, derivées de l'oeuvre de Pasteur et imposées à nos consciences par les sentiments plus vifs de solidarité que dévelope la civilization, constitue ce que nous appelons l'hygiène sociale. On peut envisager celle-ci comme la base même de la politique, science encore au berceau, quoique née déjà bien des siècles avant *Aristote, mais science* qui a ou plutôt qui devrait avoir pour essentiel object la conduite des peuples.[6]

Prophetic words! To-day in a world distracted, crippled, poisoned by the venom of war, there has risen one star of real hope—those efforts under the League of Nations, through the activities of the International Red Cross, to extend this work of Social Hygiene in its broadest sense. In this one field all have joined hands. In this one field jealousies, suspicions, selfishness, self-interest, are drowned in a common will to unite in combating the ravages of disease; in making the world a safer, better place to live in, that man may be stronger, wiser, saner; that the future may be spared some of the tragedies that we have known.

How far these beginnings may lead, we know not, for the future is veiled from the eyes of men. But this we know; they can lead only to better days.

The world is one in its will to strive for the continuation of the work of Pasteur.

France gave to the world this man—France, to whom humanity and civilization owe so much of that on which they rest—France, serene, wise, radiant with the beauty that was Greece—France, to whom we of the western world owe our existence as a nation—We salute you in the name of your greatest son! Through him you have laid the foundations of the true science of politics that shall one day bring a fuller measure of peace and happiness to a troubled world!

WILLIAM SYDNEY THAYER

REPLY TO AMERICA

A HALF century ago on the other side of the Atlantic a nation began to take cognizance of itself, young, confident in its healthy vigour, impatient in its forward march, reaching out eagerly towards the future, knowing no obstacle to its will to attain generous ends.

[6] "From a social standpoint the work of Pasteur has been no less fruitful. In revealing to us the causes of disease, in showing us that these causes may be controlled, it has profoundly modified the old conceptions of the duty of society to the sick.

"This body of new conceptions springing from the work of Pasteur and imposed on our conscience by the more acute sense of solidarity developed by civilization constitutes that which we call social hygiene. This one may regard as the very corner-stone of politics, a science yet in its cradle, although born centuries before Aristotle; a science, however, the essential object of which is, or rather should be, the conduct of peoples."

One of its own poets[1] prophetically said: ". . . ,
Whence to arise inevitable in time, the towering roofs, the lamps,
The solid-planted spires tall shooting to the stars."

And soon Europe felt herself fanned by the breath which from the Pacific to the Atlantic animated the new world. America brought a new youth to the universe.

At the same time there arose on the soil of France a man whose genius was to penetrate to the very foundations of life and to liberate humanity from the bonds which enslaved it to deadly plagues. This man who had made himself—a "self-made man" according to your fine expression—was gifted with most exceptional virtues, without which he could not have built up the gigantic structure of his work which was to be the greatest revolution in the domain of the mind that the world had ever known.

Enthusiasm dominated his character and magnified his life. He had faith in his mission. He went straight to his end towards the great horizons that his genius divined already at the age of 26. His poetic imagination gave wings to his thought, but he knew how to discipline himself, and, by a severe control, to become his own implacable adversary. Tenacious, indefatigable in his pursuit of truth, he knew not discouragement and repeated continually to his disciples: "No effort is lost." Skepticism alone was hateful to him and to his fascinating spirit. His mind full of speculations, the most prodigious that had issued from the human brain had, always practical realizations for its goal, for he was ever obsessed by a sense of duty to render service and considered science as a dispenser of blessings. He was audacious and like all great leaders of men he knew how to play his all at the decisive moment. He was attracted by all that is great and beautiful. His motto was: "Look upwards, peer into the beyond, seek always to raise yourself." He loved his country with a passionate love, and wished that upon her might shine the lustre of his discoveries; but he did not distingiush love of country from love of humanity. His generous soul looked toward the intellectual and moral union of all nations. His pity covered the world, that pity forever active which prompted him to say: "One does not ask of an unfortunate, 'Of what country or of what religion are you?' One says to him: 'You suffer.' That is enough; you are mine, and I will help you.'"

America recognized herself in this son of France. All the virtues that make peoples great, these she found united in him. She took him for model and guide. He became her ideal.

From his laboratory in the École Normale, empty, without endowment, without credit, Pasteur had written: "Concern yourselves, I beg of you, with these sacred dwellings that we designate with the expressive term, *laboratories*. Demand that they be multiplied, that they be adorned; these are the temples of the future; the temples of wealth and happiness. There it is that humanity grows and becomes better. There it learns to read in the atcivities of nature manifestations of progress and universal harmony, while these activities of themselves are too often those of barbarism, fanaticism and destruction."

Then one saw rising on the soil of America, on every side, universities and professional schools such as the Johns Hopkins, great laboratories, those admirable institutions such as the Rockefeller Institution, which are your pride and your glory. The dream of Pasteur became a reality and more. Your laboratories were animated by the intellectual sons of Pasteur, Flexner, Theobald Smith, Noguchi, Carrel, MacCallum, Loeb and so many others. Their discoveries were the offspring of the methods of Pasteur. All Pasteur's discoveries in chemistry, in agriculture, in medicine, in hygiene, America applied them and developed them. Deadly epidemics she knew no more. Her children by thousands were snatched from the clutches of death. She pushed back the limits of human life and diminished suffering. Her unhealthy spots were transformed into prosperous regions. She became the land of promise that we coveted. In a few years she realized an expansion such as one had not seen in the history of mankind. No conception seemed too daring for her. With her realization kept pace with thought. Her most audacious enterprises were so many successes.

Perseverance in effort, tenacity in the pursuit of the end to be attained, certitude that all is possible to him who knows how to will; enthusiasm for all causes that were just and true; love of country combined with love of humanity; all the guiding qualities of Pasteur, your children reached out to grasp them. And before your universities, in your public places, in your laboratories and your hospitals and your colleges, everywhere stands the tutelary effigy of him whom you venerate.

How deep was my emotion, 18 months ago, when I found in your country that cult of Pasteur, a cult springing from comprehension, admiration and love! You who came to fight by the side of that people which gave Pasteur to the world, it was your desire some months ago in Philadelphia, in New York, in Chicago, it was your desire to-day in this ceremony which will remain dear to all Frenchmen, that your hearts should once more thrill in unison with ours, and—one of those touching thoughts which are so characteristic of you—you have sent two of your distinguished pathologists whom we venerate and love, Professor Welch and Professor Thayer, to celebrate our Pasteur, who is yours, too.

In this hymn of gratitude which has been rising

[1] Walt Whitman: "Leaves of Grass."

from all nations for the last six months—that which Pasteur would have appreciated beyond all—it is as a resurgence of hope of humanity for peace and concord among the peoples of the world. And at this moment does it not seem to you, gentlemen, that Pasteur is here among us, as he was thirty years ago on his seventieth anniversary? Do you not hear him say to you as he did then, those words which should become a reality: "You bring me the deepest joy that can come to a man who believes invincibly that science and peace will triumph over ignorance and war, that the peoples of the world will come together, not to destroy but to build, and that the future is to those who have rendered the greatest service to suffering humanity."

PASTEUR VALLÉRY-RADOT

PARIS, FRANCE

THE AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE

THE CINCINNATI MEETING

PREPARATIONS for the third Cincinnati meeting, which will celebrate the seventy-fifth anniversary of the founding of the association, are in an advanced stage. The meeting is to open on Thursday, December 27, and will close on Wednesday, January 2. The general secretary and the permanent secretary recently visited Cincinnati and conferred with members of the local committee that has charge of preliminary arrangements. The local committee, under the able chairmanship of Professor Louis T. More, has everything well in hand. Especially has Professor Edgar Dow Gilman, secretary of the committee, rendered very efficient and invaluable service to the association and to the thirty societies that are to meet with the association at Cincinnati. Nearly all the meeting rooms have already been assigned, and arrangements have been made for the several general sessions, for the exhibition of apparatus, etc., and for the registration offices.

The preliminary announcement of the approaching meeting, a booklet of eighty-five pages, has just been issued from the permanent secretary's office. Copies have been sent to all members of the association and to others who are members of societies that are to take part—as far as the requisite lists have been furnished by the societies. The booklet contains more information concerning the approaching meeting than has been possible in the case of any similar announcement in past years. Also, it has been possible to publish this announcement earlier than in recent years, because of improving cooperation among the Washington office, the local committee and the section and society secretaries and committees.

The most important message carried by the announcement is perhaps the statement that reduced railway rates are available for those who are to attend, from practically the whole of the United States and Canada. These are to be secured on the certificate plan, as in recent years. A first-class, full-fare, one-way ticket to Cincinnati should be purchased and a *certificate* for the American Association for the Advancement of Science meeting, on *standard certificate form*, should be secured. The certificate is to be left at the validation desk in the registration room, upon arrival; it will be endorsed and validated without further attention from its owner and may be secured at the same desk on a later day. The railway agents at Cincinnati will sell each holder of an endorsed and validated certificate a continuous-passage return ticket for one half of the regular fare, by the same route as that followed in the trip to Cincinnati. Thus the round-trip will cost those who attend the meeting an amount equal to one and one half times the regular one-way fare. This privilege will be available to all who are members or associates of the association in good standing, or who are members of any society or organization meeting with the association at this time, or who are members of any society officially associated or affiliated with the association, or who are delegates from institutions or personal guests of persons entitled to reduced rates. Registration will be necessary in order to secure the reduced railway rates, and all who register will receive the badge for the meeting and a copy of the general program.

Several new features will characterize the seventy-fifth anniversary meeting. There will be a prize of one thousand dollars awarded to some person presenting a notable contribution to the advancement of science, either before the association as such or before one of the societies. It is planned that several supplements to the general program will be issued as the meeting proceeds, thus bringing to publication any program material that may be received too late for inclusion in the regular edition, additions, corrections, etc. An exhibition of scientific apparatus, products and books is being arranged and a good number of exhibits are already entered. It is hoped that the exhibition may be a very important feature of this meeting and that future exhibitions may be of progressively greater importance. Those desiring to enter exhibits should make arrangements with Professor R. E. Oesper, chairman of the sub-committee on exhibition, the University of Cincinnati. Professer Oesper has given much time and attention to preparations for this feature of the meeting. The association's collection of portraits and autograph letters of its past presidents will be exhibited for the first time at Cincinnati.

The opening session will occur on Thursday evening, December 27, under the presidency of Dr. Charles D. Walcott, secretary of the Smithsonian Institution.

The lecture of the evening will be given by Dr. J. Playfair McMurrich, of the University of Toronto, who is retiring president of the association.

On Friday afternoon, Mrs. Charles D. Walcott, of Washington, will show some of a fine collection of lantern slides colored by herself, from photographs she has taken of wild flowers of the Canadian Rockies. Mrs. Walcott will give explanations and present observations on the habitats of the plants represented. She has spent many years in the preparation of these slides.

The second annual Sigma Xi lecture, under the joint auspices of the association and the society of Sigma Xi, will be given on Friday evening, December 28, in the auditorium of the Hughes High School, by Dr. Willis Rodney Whitney, director of the research laboratory of the General Electric Company, Schenectady. The topic of the lecture is to be "The Vacuum, There's Something in It," and it will be illustrated by experimental demonstrations of the latest developments in the field of vacuum tubes.

In celebration of the seventy-fifth anniversary, the Saturday evening session is to be devoted to short addresses by a number of past presidents of the association. Dr. T. C. Mendenhall and Dr. T. C. Chamberlin are among the older past presidents who expect to be present. It is regretted that Professor Edward S. Morse, the past president of longest standing, will not be able to attend, but it is hoped that a letter from him may be read.

An important paper on the history of the association is to be read by Dr. Herman L. Fairchild, emeritus professor of geology in the University of Rochester. This will probably occur on Saturday afternoon. It is expected that Dr. Nevin M. Fenneman, professor of geology and geography in the University of Cincinnati, will deliver a lecture on the geology of the Cincinnati region, illustrated with lantern slides. This is planned for Monday evening.

A complimentary concert by the Cincinnati Symphony Orchestra on Sunday afternoon will be a very attractive feature of the meeting. A general reception to those in attendance will be given by the University of Cincinnati on Thursday evening, following the opening session.

The preliminary announcement contains the usual list of hotels and their rates. The general headquarters of the association will be at the Hotel Sinton, where many of the societies also will have their headquarters. Other societies are to have headquarters at the Hotel Gibson and other hotels. Those who desire hotel accommodations for the meeting should engage them at once by writing to the hotel.

Very excellent arrangements have been made for daily luncheons, in the cafeterias of the university and of Hughes High School, in the vicinity.

Every person whose name occurs as author of a paper on the program, as the information reaches the Washington office, is being requested, by special letter, to send to Science Service, 1115 Connecticut Ave., Washington, D. C., a brief and clear abstract of his paper. These abstracts will be used by Science Service and the publicity committee for the meeting. It is hoped that all who receive these requests will respond very promptly, so that the publicity work may be largely completed in advance. In recent years the association meetings have been given increasingly satisfactory publicity service by the daily press throughout the country. Those who are to present papers are urged to help in this important aspect of the meeting by not failing to supply Science Service with suitable abstracts of their contributions. The material of any paper will not be released until the day on which the paper is to be read.

Persons attending the meeting may have mail, etc., addressed to them in care of the American Association for the Advancement of Science, Registration room, Women's Building, University of Cincinnati.

The section organizations of the association, and the numerous scientific societies that are to meet with the association this year, will hold numerous sessions for the reading of papers and the delivering of addresses, by leaders and specialists in nearly all branches of science. Sixteen pages of the preliminary announcement are devoted to a summary account of these sessions. The American Mathematical Society (Chicago Section) and the Mathematical Association of America will meet with Section A. The American Physical Society and the American Meteorological Society will meet with Section B. The first joint intersectional meeting of the American Chemical Society with Section C will occur at Cincinnati. It has now been several years since the American Chemical Society has appeared in the chemical programs of the annual gatherings of the association and it is expected that the cooperation of the society will add much to the interest and value of this meeting. Astronomy will be represented by several sessions of Section D, and geology and geography will be represented by an unusually fine program of Section E, as well as by the sessions of the Association of American Geographers and the National Council of Geography Teachers. The American Society of Zoologists, the Entomological Society of America, the American Association of Economic Entomologists, and the Wilson Ornithological Club, will all hold many important sessions devoted to zoological science. Botanical sciences will be cared for by sessions of Section G and of the Botanical Society of America and the American Phytopathological Society. The American Society of Naturalists, the Ecological Society of America and the American Nature-Study Society will

hold important sessions in connection with Sections F and G. There will be sessions of Section H and an Anthropologists' dinner. There will be a session devoted to intelligence tests by Section I. Section K will present several sessions on the general topic, "Social and Economic Progress since the War." The Metric Association will hold its annual meeting and dinner. The history of science will be well represented at the seventy-fifth anniversary meeting, not only by special sessions on this subject under Section L, but also by many papers and addresses in the various sections and societies. A special program and conference on philological sciences is being arranged, also under Section L, and a session on auxiliary language is being planned. In connection with Section L the National Association of Teachers of Speech will hold its annual meeting, with some specially important features. A session will be devoted to engineering by Section M. Two sessions have been arranged on scientific questions related to medicine by Section N. Agriculture will be represented by sessions of Section O and the American Society of Agronomy, the American Society for Horticultural Science, the Potato Association of America and the Association of Official Seed Analysts. Section Q will hold several sessions on education, with important programs.

The preliminary announcement includes the usual lists of association officers, council members, committees, etc.

Business to come before the council or the executive committee at Cincinnati should be in the hands of the permanent secretary by December 20. The executive committee will hold a session on Wednesday evening and another on Thursday forenoon. The council will hold its main session on Thursday afternoon. The secretaries of the sections and the members of the executive committee are to meet and dine together Sunday evening.

The third Cincinnati meeting promises to be one of the most important meetings in the history of the association and it will surely be worthy of its special characterization as the seventy-fifth anniversary meeting. All who are interested in the progress of science and education, who are not to attend other scientific meetings occurring in convocation week this year, should not fail to come to Cincinnati.

Burton E. Livingston,
Permanent Secretary.

SCIENTIFIC EVENTS

THE IMPERIAL INSTITUTE

We learn from the London *Times* that the report of the committee appointed (under the chairmanship of Mr. Ormsby-Gore) to inquire into the activities of the Imperial Institute and the resolutions passed by the Imperial Economic Conference on considering that report have been issued as a White Paper. After a review of the history and work of the institute the committee declare:

> The founders' conception of one great Imperial organization displaying all the resources of the empire and advancing the work of empire development in scientific and industrial research and in technical and commercial education was a memorable one. At the present day, however, it seems to us that the existence of such an institution is no longer within the bounds of practical possibility. The rapid advance of the Dominions as self-governing communities within the empire, the wonderful developments in commerce and industry, the great progress in science and the ever-increasing complexity of mechanical inventions during the last generation, and the growth of numerous departments of state and of various public and semi-official institutions engaged in specialized research of one form or another have all tended to make the aims of such a central organization as the institute was originally meant to be impossible of achievement.

The committee recommended that the institute should discontinue the attempt to illustrate by means of exhibition galleries the natural resources of the empire, and that a really representative selection of empire products be made for the purpose of a traveling exhibition of a purely educational character, and that the possibility of organizing traveling exhibitions of the staple products of the colonies and protectorates in the appropriate trade centers should be considered.

The Imperial Institute should, however, continue to function at South Kensington as a clearing house of intelligence and information, equipped with laboratories to enable it to carry on only the work of preliminary analysis and investigation of raw materials. All inquiries entailing elaborate investigation or real scientific research should be referred to the competent authorities. Reliable up-to-date sample rooms, illustrative of important empire raw materials, should be maintained.

Recommendations were also made as to the future management of the institute, and the scheme was made dependent upon the support of the oversea governments being promised for a definite period. The annual cost of the institute under the committee's scheme is estimated at about £40,000 a year. The complete amalgamation of the Imperial Mineral Resources Bureau and the institute was advocated, and it was proposed that the institute should be made responsible to the Department of Overseas Trade. Failing the support of oversea governments, an alternative scheme was drawn up by which the institute could carry on the most essential feature of its present work—*i.e.*, that of an intelligence and informa-

tion bureau, without laboratories.

In view of the changes in the constitution of the Imperial Institute which have been decided upon, Professor Wyndham R. Dunstan, F.R.S., will resign the directorship of the institute next month, to which he was appointed in 1903.

ENGLISH VITAL STATISTICS[1]

THE registrar-general's statistical review of England and Wales for 1922, which has just been published, shows the lowest birth rate recorded in any year, save the war years 1917–1919; the lowest death rate, except in 1920 and 1921, and the lowest infant mortality ever recorded.

Births numbered 780,124, equivalent to a rate of 20.4 per thousand living, and were fewer by 68,690 than in 1921. Excluding the three years mentioned, we have to go back as far as 1869 to find a year in which the births reached so low a figure, and at that date the population was only 22,000,000, against 38,000,000 in the year under review. Before the war, the male births were in proportion of 1,038 to 1,000 female births. From 1916 onward, however, the plurality of males showed a decided increase, the average for the five years from 1916 to 1920 being as high as 1,051, at which figure it remained in 1921. Last year the proportion fell slightly, to 1,049, but it is still, as will be seen, considerably in excess of the prewar figure. The proportion of illegitimate to total births fell slightly, from 45 per thousand in 1921 to 44 in 1922.

Deaths numbered 486,229, equivalent to a rate of 12.8 per thousand living, and were 27,600 more than in 1921, when the lowest death rate (12.1) was recorded. If the population is standardized to the sex and age constitution of 1901, the rate is reduced to 11.9. As usual, the male deaths exceeded the female; the numbers were: Males, 246,670; females, 239,559, so that the ratio of deaths was 1,029 males to 1,000 females. As, however, there is a large excess of females over males in our population, this ratio does not give a true idea of the proportion of male to female deaths in terms of equal numbers. The death rate for males was 13.6 per thousand living, that for females 12.0. A notable feature of the death rates (standardized) is that for ages 0–5 and 5–10 years the rates are the lowest ever recorded—that for 0–5 being 1.6 and that for 5–10 being 0.2 per thousand living at those ages below the record of the year 1921. For ages 10–15 the rate remained unchanged, but from that point onward the rates show increases over 1921, growing more pronounced at the higher ages. Indeed, the rate at ages over 85 is in excess of any since 1915. The most important cause of the rise in the death rate over that of 1921 was influenza, which claimed 21,498 victims, as against only 8,995 in the preceding year. Thus, this one disease alone was responsible for nearly half the increase in deaths recorded. Diseases of the heart caused 59,837 deaths, an increase of 6,127 over the number for 1921; bronchitis claimed 40,912 victims, as compared with 33,684 in 1921, and pneumonia 40,930, as compared with 34,708.

With an infant mortality rate of 77 per thousand births, 1922 beat all records, the lowest rate heretofore recorded being 80 in 1920. The progress made in the saving of infant life is shown by going back only to the beginning of the present century. In 1901 the rate was 151, nearly double that of 1922. How important this saving of infant life is, in view of the declining birth rate, may be appreciated from the fact that, while in 1901 the births were nearly 150,000 more than in 1922, the survivors in the latter year were only 60,000 fewer. Thus, by the improvement in our infant death rate, more than half the decline in the numbers of births has been made up. The number of deaths of infants under one year of age in 1922 was 60,121; had the infant mortality rate been equal to that of 1901, the number would have been nearly 118,000.

[1] The *Journal* of the American Medical Association.

AWARDS OF THE ELLIOT MEDAL FOR THE YEARS 1921, 1922, 1923

GRATIFYING response has been made to the request of the Elliot Medal Award Committee for nominations for the award. Titles of many interesting and valuable works have been submitted for each of the years for which the awards are to be made by the National Academy of Sciences in the spring of 1924. The committee desires again to call attention to the terms of the Deed of Gift, which are as follows:

> One such medal and diploma shall be given in each year and they, with any unexpended balance of income for the year, shall be awarded by the said National Academy of Sciences to the author of such paper, essay or other work upon some branch of zoology or palaeontology published during the year as in the opinion of the . . . judges in that regard shall be the most meritorious and worthy of honor. The medal and diploma and surplus income shall not, however, for more than two years successively, be awarded for treatises upon any one branch of either of the sciences above mentioned.
>
> . . .
>
> As science is not national the medal and diploma and surplus income may be conferred upon naturalists of any country, and as men eminent in their respective lines of scientific research will act as judges, . . . no person acting as such judge shall be deemed on that account ineligible to receive this annual gift . . . if, in the opinion of his associates, he shall, by reason of the ex-

cellence of any treatise published by him during the year, be entitled to receive them.

The committee will be glad to receive further nominations up to the close of the year 1923, which should be addressed to the secretary of the National Academy of Sciences, Smithsonian Institution, Washington, D. C.

THE COMMITTEE ON PACIFIC INVESTIGATIONS OF THE NATIONAL RESEARCH COUNCIL

FOR some years the Division of Foreign Relations of the National Research Council has maintained a committee on Pacific investigations. The purposes of this committee have been to encourage research undertakings in the Pacific area, especially of problems which are peculiar to that region. The committee has also represented American scientific interests in two Pan-Pacific Science Congresses which have been held, one at Honolulu in 1920 and the second this last summer in Australia.

The committee represents the continuation of a movement which was begun a number of years ago, making for concerted study of the scientific problems of the Pacific area, regarding that area as a distinct regional unit. This movement dates back to the organization of a committee in the National Academy of Sciences to direct attention to the importance of developing scientific work in the countries within and bordering upon the Pacific Ocean, both for the welfare of that region itself and also on account of the important contributions to scientific knowledge which would come from such studies. The early formation of the committee reflected interest in these problems which had been taken by scientific men of the Pacific Coast and by others who had had an opportunity to work upon materials from the Pacific region.

The Committee of the Research Council has recently been enlarged and now consists of the following members: *Chairman*, Herbert E. Gregory; *vice-chairman*, T. Wayland Vaughan; William Bowie, Barton W. Evermann, Elmer D. Merrill, John C. Merriam, W. E. Ritter, Leonhard Stejneger, Walter T. Swingle, Clark Wissler.

THE ROLLIN D. SALISBURY MEMORIAL FUND

THE University of Chicago announces that a committee, consisting of Thomas E. Donnelley, chairman, from the board of trustees; Professor H. H. Barrows, chairman of the department of geography; Professor E. S. Bastin, chairman of the department of geology, and two other persons not members of the board of trustees or of the university faculties, has been appointed to raise a fund of $100,000 to $150,000 to be known as the Rollin D. Salisbury Memorial Fund for the Promotion of Research in the Fields of Geology and Geography.

The income from the fund is to be used for the following specific classes of projects: (a) Field research expeditions; (b) office and laboratory researches; (c) research fellowship grants to graduate students of special promise for the conduct of specific researches; (d) aid in the publication of research results when such publication can not be otherwise arranged; and (e) other projects that come appropriately under the caption of promotion of research.

Professor Salisbury, who for over twenty years was dean of the Ogden Graduate School of Science, head of the department of geography for sixteen years, and head of the department of geology at the time of his death in 1922, left a bequest to the university of a large fund for the endowment of scientific fellowships. Dean Salisbury's influence was widely extended through graduates in geology and geography who have gone to important positions in many educational institutions.

SCIENTIFIC NOTES AND NEWS

THE REVEREND THOMAS GEORGE BONNEY, the distinguished English geologist, died at Cambridge on December 9, aged ninety years.

THE Perkin Medal, awarded annually to a chemist, residing in the United States, for the most valuable achievement in applied chemistry, has this year been awarded to Dr. Fred. M. Becket, distinguished for his work in metallurgy. The presentation will take place at the January 11 meeting of the American Section of the Society of Chemical Industry, Chemists' Club, New York City.

DR. EMIL G. BECK, Chicago, has been awarded its medal by the Radiological Society of North America for his work on radiology.

DR. F. GOWLAND HOPKINS, F.R.S., distinguished for his work on vitamins, has been presented with the gold medal of the Royal Society of Medicine, London.

THE jubilee prize of the Swedish Medical Association has been awarded Dr. R. Fahræus for his report on the speed of sedimentation of erythrocytes, entitled "The suspension stability of the blood." The Lennmalm prize is to be awarded to Dr. Sven Ingvar for his series of works on the cerebellum.

PROFESSOR CARLOS CHAGAS, director of the Institut Osvaldo Cruz in Rio de Janeiro, has been appointed foreign correspondent of the Belgian Royal Academy of Medicine.

THE resignation of Dr. Henry Frank Moore as

deputy commissioner of fisheries became effective October 31, terminating a distinguished service of twenty-seven years with the Bureau of Fisheries. Dr. Moore is succeeded by Lewis Radcliffe, a member of the bureau from 1907 until 1922, when he resigned as assistant in charge of the division of fishery industries to accept a position with the Tariff Commission.

DR. BELA SCHICK, author of the Schick test, has accepted an appointment as head of the children's service division of Mount Sinai Hospital, New York City.

M. JEAN BOSLER has been appointed director of the Marseilles Observatory.

AT a meeting of the International Committee on Marine Fisheries Investigations, Dr. H. B. Bigelow was elected permanent chairman, to succeed Dr. H. Frank Moore, resigned.

DR. ANDREW BALFOUR, retiring director of the Wellcome Bureau of Scientific Research, has been appointed the first director of the School of Hygiene, London, toward the building and equipment of which two million dollars was contributed by the Rockefeller Foundation. Dr. Balfour, before taking up his duties as director of the School of Hygiene, will carry out a mission he has already undertaken to Bermuda.

DR. H. A. GLEASON, of the New York Botanical Garden, has resigned his position as assistant director to become curator, without reduction of salary, in the same institution, and will henceforth devote his time chiefly to the investigation of the flora of northern South America. Dr. Marshall A. Howe, for many years curator, becomes assistant director.

DR. J. F. GUDERNATSCH, for twelve years a member of the faculty of Cornell University Medical College, has joined the scientific staff of the Hoffman-La Roche Chemical Works.

DR. DONALD K. TRESSLER, who has been working on the determination of iodine in sea foods for the past few months, has resigned from the service of the Bureau of Fisheries to accept an industrial fellowship in the Mellon Institute of Industrial Research of the University of Pittsburgh. He will carry out researches on chemical problems of the beet-sugar industry.

DR. ASA C. CHANDLER has resigned from the Rice Institute, Houston, Texas, to accept a position as head of the department of helminthology in the School of Tropical Medicine at Calcutta, where he will devote most of his time to research on the hookworm disease. Dr. Chandler will sail for India early in January.

DRS. T. WAYLAND VAUGHAN and A. H. BROOKS, who represented the Geological Survey at the Pan-Pacific Scientific Congress in Australia, have returned to Washington.

PAUL C. STANDLEY, of the National Museum, left recently for Panama, where he is to continue the investigation of the flora of the Canal Zone, a work commenced several years ago.

THE Swarthmore College chapter of Sigma Xi held its opening meeting for the current year on November 27 in the Sproul Observatory. The results of the observatory eclipse expedition to Mexico last summer were presented by three members of the party. Director John A. Miller spoke on the observations taken for testing the Einstein theory, Dr. Ross W. Marriott discussed the corona photographs with the sixty-five foot camera, and Dr. W. R. Wright reported the spectroscopic program of the expedition.

DR. LOUIS A. BAUER gave an illustrated lecture "On the origin of the earth's magnetic and electric fields" before the departments of physics, electricity and geology of the Brooklyn Institute of Arts and Sciences on November 24. At Boston, on December 8, he gave an illustrated lecture entitled "The earth and sun as great magnets" before the Eastern Association of Physics Teachers.

AMONG the lectures announced for January, at the Carnegie Institute of Technology, are a series by Professor Harry N. Holmes, of Oberlin College, who will discuss "Colloid Chemistry," "Emulsions" and "Gels" on January 9, 10 and 11; and a series by Professor Alfred Stansfield, of McGill University, between January 14 and 19 on "The Electric Furnace for Iron and Steel."

PROFESSORS GEORGE D. BIRKHOFF, of Harvard University, and Raymond C. Archibald, of Brown University, will lecture on mathematics at the University of California during the summer of 1924.

ON November 17, Dr. Arthur L. Day, director of the Geophysical Laboratory, Washington, D. C., delivered an address at Toronto to The Royal Canadian Institute on the subject "Earthquakes and volcanic eruptions."

AT a meeting called by the Maryland Cancer Committee in Baltimore on November 18, methods for disseminating information concerning cancer were discussed. The speakers included: Dr. William H. Welch, director of the School of Hygiene and Public Health, of the Johns Hopkins University; Dr. C. Hampson Jones, health commissioner of Baltimore; Surgeon-General Hugh S. Cumming, U. S. Public Health Service; Dr. Joseph C. Bloodgood, Baltimore, and Dr. George A. Soper, new managing director of the American Society for the Control of Cancer.

THE Canadian Medical Association has arranged for a Lister oration to be given once every three years. The first oration will be given at the annual meeting of the Association at Ottawa in 1924 by Dr. John Stewart, of Halifax, who is a former house-surgeon of Lister's.

THE Royal Institution has received from Mr. Robert Mond a gift of busts and medallions of Dr. Ludwig Mond, Cannizzaro, Liebig, Berzelius, and others, and many portraits and photographs.

AT a recent meeting of the senate of the University of London, it was resolved that the physiological laboratory library should be kept together as part of the university library and be developed in connection therewith as a memorial to the late Professor A. D. Waller.

THE Clare Vaughan Infirmary at the Detroit Tuberculosis Sanatorium, Northville, was dedicated November 15 to the memory of Dr. Victor Clarence Vaughan, Jr., who died in service in France, June 4, 1919. Dr. Vaughan was the son of Professor Victor C. Vaughan, of the University of Michigan.

NEAR the new home of the New York Academy of Medicine on Sixtieth Street an eleven story office building for the exclusive use of the medical profession will be erected at a cost of $850,000.

THE American Public Health Association has announced that at its fifty-second annual meeting at Boston in October, two new sections were established. They are a Section on Health Education and Publicity and a Section on Public Health Nursing. The divisions in the association now are as follows: Public Health Administration, Laboratory, Vital Statistics, Food and Drugs, Sanitary Engineering, Industrial Hygiene, Child Hygiene, Health Education and Publicity, and Public Health Nursing.

THE *Journal* of the American Medical Association says that the national committees on international cooperation in intellectual work, which have now been appointed in seventeen countries of Europe, were invited to send delegates to the meeting of the International Committee on Intellectual Cooperation, organized by the League of Nations, which was held at Paris on November 28. These national committees will serve as correspondents and collaborators to the international committee in encouraging and facilitating intellectual cooperation among the nations. Since the last meeting of the League of Nations, national committees have been created or are in process of formation in Belgium, France, Latvia, Norway, the Netherlands and Switzerland. Similar committees were already in existence in Austria, Bulgaria, Esthonia, Finland, Greece, Hungary, Lithuania, Poland, Roumania, Czechoslovakia, and in the kingdom of the Serbs, Croatians and Slovenians.

EARLY in January Dr. Thomas Barbour, of the Museum of Comparative Zoology, accompanied by Dr. Edward Wigglesworth and Mr. W. S. Brooks, both of the Boston Museum of Natural History, will go to Cuba and Central America for an extended visit. The principal object of the trip is to start work on the organization of the biological station to be erected on Barro Colorado Island in Gatun Lake. This island is a beautiful area of virgin, tropical rain forest about six square miles in extent. Chiefly through the influence of Drs. Wheeler, Piper, Strong and Mr. James Zetek, of Ancon, Governor Morrow set aside the island, in perpetuity, as a forest reservation to be used in connection with a biological station. This station is to be managed by the executive committee of the Institute for Research in Tropical America, an organization initiated by the National Research Council. The institute is supported by the museums and colleges of America which are each asked to give a small annual grant towards maintenance. The initial funds to start building operations on the island are now being raised by the executive committee. Dr. Barbour hopes before he leaves Panama to have trails cut through the island jungle, to have a safe water supply established and some sort of living quarters erected so that the large number of naturalists who have expressed their desire to visit the island during the coming summer vacation will find reasonable accommodations for their work.

UNIVERSITY AND EDUCATIONAL NOTES

MRS. ALFRED H. ANDERSON, widow of a pioneer lumberman of Seattle, has presented to the board of regents of the University of Washington $250,000 to be expended for a building to be called the "Alfred H. Anderson Hall of the College of Forestry," in memory of her husband. The building will be constructed at once near the present Forest Products Laboratory.

THE Harvard School of Public Health formally opened its school building on Van Dyke Street, Boston, on November 21. The building which was formerly the Boston Infants' Hospital was purchased by the School of Public Health and entirely renovated.

WORK will start in the spring on the McKinley Hospital on the campus of the University of Illinois, Champaign. This $150,000 building, a gift of Senator William B. McKinley, will be one of a group which will form the south quadrangle. It will be three stories high and have a capacity of sixty beds.

THE University of California College of Dentistry has established a Lecture Foundation on Preventive Dentistry, the initial endowment being $10,000. The intention of the foundation is to present the most

recent knowledge relating to the prevention of diseases of the mouth and teeth. The prevalence and seriousness of these insidious disorders are widely recognized but not fully understood, and the faculty and alumni hold that the duty of preventing disease and promoting public health is fully as important as the relief and reparative treatment so universally needed. Dr. Arthur D. Black, dean of the Northwestern University Dental School, has been invited to give the first series of lectures. It is proposed to give the series in San Francisco and Los Angeles.

DR. MELVIN A. MARTIN, A.B. (Richmond), A.M. (Chicago), Ph.D. (Columbia), has become professor of psychology in Newcomb College, Tulane University, succeeding Dr. J. M. Fletcher.

ADDITIONS to the faculty of medicine at Dalhousie University, Halifax, N. S., as reported to the *Journal* of the American Medical Association are as follows: Clyde Holland and Margaret Chase have been appointed to full-time positions in the departments of anatomy and pathology, respectively; R. J. Bean, formerly on the staff of Western Reserve University, has been appointed associate professor of histology and embryology; Professor E. Gordon Young, associate professor of biochemistry at Western Ontario University, has been made head of the department of biochemistry; Professor J. N. Gowanloch has been appointed to succeed Professor J. A. Dawson in the department of biology. The recent affiliation of King's and Dalhousie has combined the teaching force of the two universities and Professor N. J. Symons, of King's, will become instructor in psychology to the medical classes, while Professor A. S. Walker, also of King's foundation, will lecture to the first year medical students on the "History of thought," a new subject.

DISCUSSION AND CORRESPONDENCE

THE JAPANESE EARTHQUAKE[1]

I AM writing to thank you for your kind letter of September 21 last and your card of the twenty-fifth expressing sympathy for the catastrophe that has befallen this country. I have the good fortune to assure you that I am perfectly right myself and that none of the Japanese parasitologists have been affected by the misfortune, except Dr. Miyajima, whose house was burnt down. The zoological building of this university, which is of brick, cracked badly and part of it is being taken down, but no serious damage has been done to its contents, and the personnel are all safe. The central library and the buildings used by the faculties of law, economics and letters, as well as those of physiological chemistry and pharmacology, have been lost by fire, which originated in the laboratory of physiological chemistry immediately after the earthquake. Very little of their contents have been saved, owing to the general disorder that ensued and the lack of the necessary water, although those who were at the spot fought bravely. The central library, which contained many works never to be obtained again, and in which were deposited several memorial collections, including the working library of the Sanscrit scholar Max Mueller, is a great loss for the university, and it will take years to have a similar one again.

At the time of the earthquake I was staying with my wife and family at a country place about fifty miles north of Tokyo, where the shock was bad enough, but not so bad as to damage the little house I was living in nor any in the neighborhood. People there told me they did not remember a similar shock for the past forty years. Towards the evening of that day, September 1, I could see at a far distance reflections of what I thought to be flame, and the same reflections were seen somewhat altered the next day, but I had no idea of what was going on in Tokyo. Then came the news that all Tokyo was in flame, that martial law was proclaimed, that nobody could get into the city owing to the disorder that prevailed there, etc., etc., and there was no means to send or receive information. The dreadful suspense we were compelled to be in was trying in the extreme. I, however, managed to get back to Tokyo with my family on the 6th, and to our great relief we found our own house and those we left in it all safe. My time has since been taken up entirely by meetings and conferences of various sorts in connection with the work of reconstruction for the university. Half of Tokyo is now a city of barracks and sheds, and the government have decided to build only temporary structures for themselves for ten years hence. I am, however, hoping to see Tokyo a better city than it used to be after some years.

The center of this destructive earthquake was in Sagami Sea, the home of so many interesting forms of life, and comes very close to filling a gap in the series of similar centers in the past, which form what has been called the "outer earthquake zone" of Japan, as you will see from the enclosed chart prepared before the late disaster. You may perhaps wonder why we do not abandon a country so often visited by earthquakes, but I think familiarity breeds contempt in this case, too. We are, however, taking lessons from our bitter experience and going to set up stronger structures for the university in the future.

I appreciate your kind consideration in connection with Mr. Morishita's paper. He has lately been in-

[1] Letter to Professor Henry B. Ward, University of Illinois.

vited by the Formosan Government to serve as parasitologist, but will stay in Tokyo till next year.

With best thanks for your sympathy, I am

Yours very truly,

SEITARO GOTO

IMPERIAL UNIVERSITY,
TOKYO, JAPAN, OCTOBER 30, 1923

EXTRACT FROM A LETTER TO DR. DAVID STARR JORDAN

No doubt you have had details from the press, but in case it may be of interest to see how quickly the American ships got started for relief we might mention that, of the two divisions (each six ships; squadron leader making 13 in all) of Destroyers, that known as the "38th" reached here from Dairen, Chinwangtao, etc., on the fifth to seventh, and Division No. 45, from Tsingtao got here about the eighth or ninth. The transport Merritt, from Manila, delayed by a typhoon, got here on the fifteenth, and the Meigs on the seventeenth—with large quantities of food, blankets and hospital supplies, etc. The destroyers practically stripped themselves of their own stores besides what extras they had been able to bring.

The Japanese have been greatly moved by the swift and open-handed policy of America and other nations; this has meant much for the morale of the nation as well as for their physical relief.

There are nearly 55,000 people still living in barracks in the chief centers for these temporary structures in Tokyo—parks, palace and temple grounds and the like, from recent official statistics. Problems of clothing, housing and employment are most difficult at present. There are over 6,000 in the little barrack village—long rows of frame (one-room divisions)—right in Hibiya Park here. You would be surprised to see the cheerful aspect of their neat little "streets"—the one where they have opened most of their shops having strings of gay lanterns suspended overhead across the street at close intervals.

We hope that the little quakes that have occurred since September 1 have not been exaggerated in the press abroad. They have not amounted to anything, being just the minor adjustments to be expected after the main shock, except perhaps for yesterday's which is said to have been independent, but not at all serious.

When we consider the courage and hard work to be seen here on every hand, and the history of San Francisco after 1906, we are sure that it will not be long before that history will be repeated here. Even now no one who may have been planning to come here need change plans.

T. INAMURU

TOKYO, NOVEMBER 6, 1923

The Imperial University of Tokyo lost its entire library, which, as I understand, though encased in a fire-proof building, had its roof lifted by an explosion in a neighboring medical school. There were between 500,000 and 700,000 volumes, many of them of ancient Japanese literature and irreplaceable.

Professor Kenzo Takahashi is now visiting the universities of America and Europe with a view to securing donations for this library. It is to be hoped that all our universities and scientific societies will respond to this appeal. Any person or institution which may wish to send one or more volumes may do so either through Professor Takahashi, or by sending them directly to Mr. T. Komatsu, director of the Toyo Kisen Kaisha, Market St., San Francisco, who will forward them without charge to Japan.

DAVID STARR JORDAN

STANFORD UNIVERSITY

THE SELECTION OF SUBJECTS FOR RESEARCH

IN the August 10 issue of SCIENCE, Dr. Eugene C. Bingham gives a discussion of this subject, with particular reference to subjects for the university. I should like to add a few words with reference to a selection for the younger students.

After stating the importance of having research problems of some value, "If the result will not be worth publication, the work is not worth attempting," he goes on to make the point that "the particular problem is of little moment to the student." For "one tiny problem quickly branches out into more fields than any one mind can compass." It is a little difficult to see how Dr. Bingham introduced philology into the study of the flow of matter, but that merely shows that Dr. Bingham has the imagination to see the connection. Another might fall down in a similar research problem, because he could not see it.

The young student can not ordinarily see such a connection, and it may be for this reason that it has come to be common practice to give them the multitude of varied courses, instead of starting them learning research. But I think the cause is more in the subjects selected. The professor is mostly interested in the fields that have been extensively studied. He wants to carry research one step further in the well-trodden road, in such directions as radioactivity, or isotopes, to mention two examples from Mr. Bingham's article. To go ahead with such subjects it is necessary first to learn the work of other leading men. Students in our colleges find it impossible to get ready to accomplish anything in such a line before graduation.

Turning to the industrial field, we find many lines which have never received the attention of a single intellect of the highest grade. There are plenty of real problems with results that would be worth pub-

lishing. Furthermore, many of these problems could be handled with but little equipment and at small expense. Why not start the student on such problems and give him a chance at learning research methods before graduation?

To be sure, such problems do not extend our knowledge of scientific laws, and so it might not be proper to call it scientific research. Instead, they are a study in finding what laws apply to particular cases in which we are interested. It is technical research rather than scientific. But it is just as truly research and uses the same methods, but the subject-matter is more in line with the age of the student.

To try to put such problems into the college course does not seem practical. One difficulty is the difference in the ability of the student and the professor to handle the problem. The professor would want the results and would see that they were obtained promptly, in this way reducing the research practically to the position of present-day laboratory experiments.

I would, therefore, suggest that the student go into the industry for his first experience at research, to some place where the results of his work would be appreciated from a financial as well as from an educational standpoint, and where he can obtain results on his own initiative that are worth publishing. As he sees the need for more general courses in various subjects, he can take these up with more interest than would be possible without his research practice.

Several advertisements have appeared recently in SCIENCE for a boy to do exactly this, but so far not a single reply has been received, not even a request for further particulars. What can be the reason? Do all parents feel that the college is the only place to study research? Or possibly they do not want their sons to go into research work? Do they feel that no business firm would take on a young boy for such purposes, and so there must be some hidden deceit about the advertisement? Is the fact that the boy receives pay instead of having to pay for it the obstacle? Or what is the reason that not a single person has been sufficiently interested to inquire about it?

A. W. FORBES

WORCESTER, MASS.

REACTIONS OF CARBON DISULFIDE WITH ALDEHYDES

IN the presence of metallic sodium, carbon disulfide condenses with bodies containing "active" hydrogen to give unstable dithio acids. The reaction has been applied to compounds which contain the group

$$\begin{array}{c} \mathrm{O} \\ \| \\ -\mathrm{CH} \end{array} \quad \text{or} \quad \begin{array}{ccc} & \mathrm{O} & \\ & \| & \cdot\,\mathrm{H} \\ - & \mathrm{C} - & \mathrm{C} - \\ & & | \end{array}$$

(aldehydes, ketones, esters, salts of organic acids) and is probably general for all substances capable of aldol condensation.

Aldehydes yield α-keto dithio acids, with ketones ethers of dithio acids are produced; ethyl formate reacts irregularly, giving sulfo-methane dicarboxylic acid. The new dithio acids have only been studied through their salts, etc.; the free acids are very unstable and have so far not been isolated.

Further work will extend the study of this reaction to other types of substances which undergo aldol condensation, and will report the preparation of the esters of the new dithio acids, which appear to be stable.

E. WERTHEIM

UNIVERSITY OF ARKANSAS

SCIENTIFIC AND INDUSTRIAL RESEARCH[1]

THE Report of the Committee of the Privy Council for Scientific and Industrial Research for 1922–23 shows the far-reaching importance of the work carried on under the auspices of this committee. The civil departments concerned in public administration, it is noted, are making larger use of the machinery now existing for the scientific attack upon problems that affect them. As part of the policy of coordination, periodic conferences have been held between representatives of the Department of Scientific and Industrial Research, the Development Commission and the Medical Research Council, at which the biological secretary of the Royal Society has been present. These conferences, the report states, have provided valuable opportunities for the consideration of such matters as the responsibility for the conduct of investigations at borderlines, the possibility of cooperative action in the conduct of investigations in which more than one of these departments may be interested, and the continuance of research work which has developed in such a way as to bring it outside the scope of the fund originally aiding it. These discussions have helped to define the common problems of human and animal disease, and have emphasized the interdependence of biological and physical research. They have driven home to the committee the conviction that a national policy in research, complex though it might be and directed by diverse and suitably designed organs, must be conceived and implemented as a unity. A series of conferences were held during the year with the management of the British Empire Exhibition, and a departmental committee was appointed to consider how science and the application of science to industries could best be represented. It was agreed with the exhibition authorities that they should ap-

[1] *The British Medical Journal.*

point a small committee, nominated by the Royal Society, to assume responsibility for the organization of the central scientific exhibit, and a larger committee, acting on behalf of the research associations, to deal with the general organization of sectional scientific exhibits. With regard to the plea that was made in last year's report that a vigorous search for new knowledge and the more effective application of science to industrial processes offered a potent means of reestablishing our country and maintaining its population, it is recorded with satisfaction that in December, 1922, an act with a similar end in view was passed in France, creating a national office for scientific and industrial researches and invention in connection with the Ministry of Public Instruction. The report includes a summary of the work of the various research boards and committees of the Department of Scientific and Industrial Research. At the National Physical Laboratory, in addition to the researches which it necessarily undertakes in the discharge of its primary functions as the custodian of national standards, with a view to the improvement of measurements of all kinds, including those relating to standards of quality, much research work of a general character is carried out. It includes researches involving continuous observations over a very extended period of time, and researches requiring the use of exceptionally expensive equipment or other special facilities—for example, work at very high voltages or at very low temperatures. The Food Investigation Board dealt with varied problems affecting fruit, meat, fish and eggs; many of these have been noted in our columns. Among new investigations which are being carried on are the design of a commercial gas store for fruit, the growth and respiration of fungi under various conditions, the study of vegetables in transit from producer to market, the autolysis of meat and of fish, the bacteriology of fish and the freezing point of eggs in relation to the risk of overcooling. A report from the Oxygen Committee, shortly to be published, contains descriptions of the improvement of the known method of handling liquid oxygen and liquid air on a practical commercial scale; of these methods the committe has been principally concerned with the development of the double-walled vacuum vessel as a container. Among the other boards and committees carrying on different branches of research work are the Fuel Research Board, the Geological Survey Board, the Radio Research Board, the Physics, Chemistry, and Engineering Coordinating Research Boards, the Fabrics Coordinating Research Committee, the Adhesives Research Committee and the Lubrication Research Committee. During the academic year 1922–23 the committee made 403 grants to research workers and students in training; of these 252 were allowances to students to enable them to take advantage of the facilities offered by various universities and colleges or other research institutions, 38 were personal grants to research workers to undertake independent research or to act as scientific assistants to other investigators, and 14 were grants to scientific workers to enable them to employ laboratory assistants or to purchase equipment; the total expenditure on these grants was £50,000. The total expenditure of the committee during the financial year was £497,549, of which £264,493 came directly from the Exchequer, while £89,608 represents fees for tests and special investigations for outside bodies, and repayments from the service departments.

SPECIAL ARTICLES

GELS AND THEORY OF ADSORPTION*

THIS paper is not to give a summary of the theories that have appeared on adsorption. Time nor patience would permit such a presentation. On the contrary, the speaker, with due consideration for all theories thus far advanced, is going to present a point of view which is in harmony with the experimental facts which have been found out at the University of Maryland during the past three years.

Before beginning our work, I felt that the hypothesis, which said that the electrical charge on the colloid was due to the adsorbed ion, was the most general. You all know that this point of view arose from Hardy's work, but was first clearly presented by Bredig. Helmholtz's double layer theory was another way of accounting for the electrical charge. Furthermore, you are all familiar with Freundlich's assumption of adsorbed ions and Michael's idea of surface molecules being dissociated.

After reviewing the great amount of work on adsorption, it seemed to me that we did not need more theories on adsorption until more fundamental work was done, in order to prove the falsity or truth of the theories already in print.

Our work was started on silica gel and you all know that this gel is negative with respect to water. We assumed that this negative charge was due to the Helmholtz double layer and, according to Hardy's work, we had reason to believe that if the hydrogen ion concentration was decreased, the negative charge on the gel would increase, and similarly, if you increase the hydrogen ion concentration the gel would assume a less negative charge until it would assume a positive charge when the pH had fallen below 7. The Helmholtz theory also assumes that a charge of a particular sign can not exist without one of oppo-

* Read before the Chemistry Section of the American Association for the Advancement of Science at the Boston Meeting on December 28, 1922.

site sign in its proximity; *i.e.*, when the silica gel becomes more and more negative by increasing the pH value of the solution, it should attract more and more positive ions into its proximity. With these points in mind, it seemed reasonable to suppose that a positive ion, such as would be furnished by some salt like potassium acid phosphate, would be more and more attracted into the neighborhood of the gel as the hydrogen ion became less; or, putting it in other words, that the adsorption of the potassium ion would increase with an increase in pH values. Results as shown in the following table seemed to bear out the supposition:

TABLE I

pH Value	mgm. K Ads. per gm. gel.	mgm. PO_4 Ads. per gm. gel.
9.501	9.63	— 4.15
7.692	6.56	— 4.15
6.086	1.74	— 3.15
3.888	— 0.68	— 1.36

This would seem quite in tune with some of Dr. Loeb's work as far as the potassium ion is concerned, and the phosphate radical also has a tendency in the right direction, although at no time did it become positively adsorbed. Many salts of potassium and calcium were run, and there was no exception to the rule as far as the cation was concerned, but the anion presented some irregularities.

It next became of interest to find if the charge on the gel changed at a pH value of 7. Such determinations were easily run by an apparatus similar to that used by Briggs in his electroendosmosis work. Table II gives a sample of the results.

TABLE II

pH	Charge on Gel.	Time to flow 10 cm.	E.M.F.
6.526	neg.	16 min. 19 sec.	116
4.717	neg.	31 min. 54 sec.	120
3.567	neg.	32 min. 19 sec.	120
1.217	pos.	72 min. 3 sec.	119

According to Perrin's work, you would not expect this silica diaphragm to be negative in such a high hydrogen ion concentration unless it was due to a strong adsorption of some negative ion which was more strongly adsorbed than hydrogen. But the anions had been slightly, if any, adsorbed as shown in Table I.

In view of these facts it seemed necessary to make some other assumption as to the cause of the charge on the gel. The next most plausible theory seemed to be the ionization of surface molecules, but before applying this theory, a few words about the history of the ultramicron may be in order.

Work by Bütschli and others have led us to believe that the ultramicron in the hydrosol and hydrogel are identical. In the latter case the ultramicrons are closer together. It is further necessary for us to picture the ultramicrons in a hydrogel as being held together by a certain amount of cohesion and the interstices between these ultramicrons being filled with water.

Suppose that the molecules of silicic acid at the surface of the ultramicron suffered ionization. Then the ultramicron would become negative and might be represented thus:

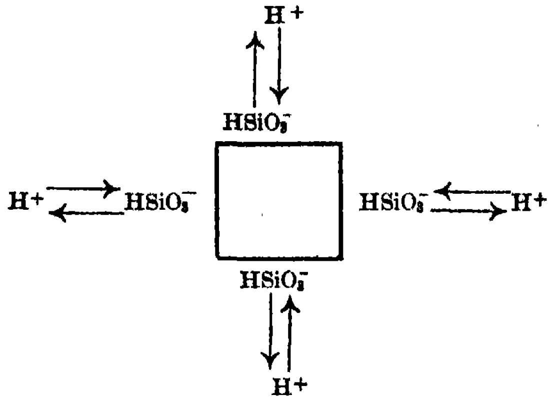


Fig. 1

The charge on the gel is now accounted for satisfactorily, and it is next to be seen if this theory will explain experimental facts.

On this theory the ultramicron should have a charge much in excess of a common ion, for, as illustrated in Figure 1, there would undoubtedly be many surface molecules ionizing. This is true to facts, for it has been shown that the charge on an ultramicron is many times that of a single ion.

Suppose an acid is added to these ultramicrons. This surface ionization will be decreased, and the gel will become less negative until it finally becomes positive, as shown in Table II. The equilibrium is expressed thus:

$$H^+ + H\text{-}SiO_3 \rightleftarrows H_2SiO_3 \rightleftarrows H^+SiO_3 + O\text{-}H$$

$\longleftarrow$ pH < 1.217 $\qquad\qquad$ pH > 1.217 $\longrightarrow$

Again, suppose that some alkali is added, such as sodium hydroxide, then the regular neutralization action should take place thus:

$$\square\, HSiO_3^- + \boxed{H^+ + OH^-} + Na^+ \longrightarrow$$
$$\square\, HSiO_3^- + Na^+ + H^+ + OH^-$$

i.e., sodium silicate is formed at the surface of the ultramicron. These surface molecules of silicate would be more highly ionized than the silicic acid and hence, the negative charge of the gel should increase. This is again true to experimental facts.

The sodium ions in equilibrium with the silicate ions on the surface of the ultramicron would have a tendency to diffuse through the solution, but they can

not go without taking the ultramicron in their train. This should happen when the ultramicron does not have too great mass, and in such a case we have what is known as peptization, but if the mass of the ultramicron is too great, the sodium ions are not able to pull it along and consequently the sodium ion is held in the vicinity of the ultramicron and we have what might be termed adsorption. Experimental facts bore out these assumptions, for when the silica gel was treated with a solution of sodium hydroxide until the alkalinity of the solution had entirely disappeared and the analysis run, it was found that part of the sodium was found in the solution with its attending ultramicrons, while the balance was in the proximity of the ultramicrons which had too great mass to migrate. The surface of the unmigratable ultramicrons is so great that the result was a fairly high so-called adsorption.

In the light of this, it was reasonable to suppose that the adsorption of potassium, as shown in Table I, might be due to a replacement of the sodium, but if this were the case, the total adsorption of the sodium and potassium should be equal to the adsorption of the sodium, and what part of this adsorption was potassium would depend on the ratio of the solubilities of sodium and potassium silicates. Furthermore, if some salt like silver nitrate were used which had a more insoluble silicate than the potassium more of the sodium should be replaced but the total adsorption should be the same. A few results are given in Table III to show the general run of experiments.

TABLE III

ADSORPTION OF METALS BY THE HYDROGELS OF SILICON

Solutions Used		Equivalents of Na Ads. per gm. Gel.	Equivalents of M.[1] Ads. per gm. Gel.	Total Equivalents of Metal Ads. per gm. of Gel.
C=0.02N	C=0.02N			
NaOH	$NaNO_3$	45×10^{-5}		45×10^{-5}
NaOH	KNO_3	14×10^{-5}	31×10^{-5}	45×10^{-5}
NaOH	$AgNO_3$	12×10^{-5}	33×10^{-5}	45×10^{-5}

Using similar notation to that already used, the reactions might be represented thus:

$$\square HSiO_3Na + KNO_3 \rightleftarrows \square HSiO_3K + NaNO_3 \quad (1)$$

$$\square HSiO_3Na + AgNO_3 \rightleftarrows \square HSiO_3Ag + NaNO_3 \quad (2)$$

According to the results given in Table III, equation (2) would be carried nearer completion than equation (1) before equilibrium was established, but the total metal adsorbed in any case is the same.

[1] Metal other than sodium.

These are a few points to show the trend of our results and conclusions in regard to silica gel. We are now investigating alumina and ferric oxide gels in order to find what theories will best apply to these cases, but the work has not yet reached such a state that we wish to draw definite conclusions, but our present work seems to indicate that there are four different types of adsorption from solution; namely, (1) chemical adsorption, which follows the mass law, (2) exchange adsorption, where one ion is adsorbed at the expense of replacing an equivalent amount of a second ion, (3) partition ratio adsorption, where the adsorption obeys Henry's law, and (4) electronic adsorption, where the adsorbed material seems to be held by a secondary valence. There is also what might be called a fifth type which is a combination of two or more of these types. We feel quite sure that we have a combination adsorption in the case of both ferric oxide and alumina gels, but we shall wait until a later date to report more detail on this.

NEIL E. GORDON

UNIVERSITY OF MARYLAND,
CHEMISTRY DEPARTMENT

NORTH CAROLINA ACADEMY OF SCIENCE

THE twenty-second annual meeting of the North Carolina Academy of Science was held at the North Carolina College for Women at Greensboro, May 4 and 5, 1923.

The secretary reported a total membership of 203, an increase of 40 members over the preceding year, and also that some 60 members were now members of the American Association for the Advancement of Science, an increase of 50 per cent. over the previous year.

The following officers were elected for the ensuing year: *President*, C. M. Heck, Department of Physics, State College; *vice-president*, J. P. Givler, Department of Biology, North Carolina College for Women; *secretary-treasurer*, Bert Cunningham, Department of Biology, Trinity College; *executive committee*—A. Henderson, Department of Mathematics, University of North Carolina; H. B. Arbuckle, Chemistry Department, Davidson College; J. W. Nowell, Chemistry Department, Wake Forest College.

The North Carolina Physics Teachers Association, meeting with the Academy, elected officers as follows: *President*, W. T. Wright, North Carolina College for Women; *vice-president*, A. A. Dixon, State College; *secretary-treasurer*, A. L. Hook, Elon College.

The North Carolina Section of the American Chemical Society, meeting at the same time and place, elected the following officers: *President*, J. O. Halverson, Department of Agriculture; *vice-president*, F. C.

Vilbrandt, Department of Chemistry, University of North Carolina; *secretary-treasurer,* L. B. Rhodes, Department of Agriculture.

The following officer was elected for the Mathematics Section: *President,* J. W. Lasley, Jr.

The following papers were presented:

Note on the pure culture of diatoms: BERT CUNNINGHAM.

On the variation of proteins in corn: O. J. THIES, JR. and H. B. ARBUCKLE.

Recent improvements in amoeba culture methods: L. M. BERTHOLF.

Soil treatment to overcome the injurious effects of toxic materials in eastern North Carolina swamp lands (read by B. W. Wells): M. E. SHERWIN.

Dedifferentiation in hydroids and ascidians: H. V. WILSON.

Density of the cell sap of plants in relation to environmental conditions: C. F. KORSTIAN.

The importance of calcium in relation to rickets (by title): J. O. HALVERSON.

Twinning and polyembryony in insects: R. W. LEIBY.

Fossil remains of an ancient mammal in East Central Texas (by title): E. O. RANDOLPH.

The present condition as to ether theories (by title): A. H. PATTERSON.

Some phases of digestion in Cambarus: W. A. WOLFF.

The physics of artificial incubation: C. M. HECK.

The copperhead snake at Raleigh (by title): C. S. BRIMLEY.

Some methods in anatomical technic (by title): W. C. GEORGE.

Contractile vacuoles in amoebae: factors influencing their formation and rate of contraction: M. J. HOGUE.

Strawberry leaf scorch: F. A. WOLF.

Some of the Hepaticae of North Carolina: H. L. BLOMQUIST.

Characteristics of North Carolina rainfall (lantern): R. J. MORTON and T. SAVILLE.

Hydrogen-ion concentration in certain trout and sunfish waters of western North Carolina (by title): R. E. COKER.

The relation of diet to the development and preservation of teeth: F. W. SHERWOOD.

A simple microphotographic apparatus: J. B. BULLITT.

The research program of the Appalachian forest experiment station (read by C. F. Korstian): E. H. FROTHINGHAM.

Savannah and sand ridge plant communities: B. W. WELLS.

Technique of the mimeograph-mimeoscope method of publishing temporary illustrated science text-books and laboratory guides for schools and colleges: J. P. GIVLER.

The generic significance of the genitalia of insects (by title): Z. P. METCALF.

Some observations on the righting reaction in starfish: B. NOYES.

Some points in the bud development of a simple ascidian (presented by H. V. Wilson): C. D. BEERS.

The formation of rat spermatozoa agglutinins in the rabbit, with a brief discussion of the problems of tissue immunity (read by Chas. Phillips): W. F. TAYLOR and H. N. GOULD.

Some biological aspects of the cancer problem: CHARLES PHILLIPS.

Oogenesis in some species of the Saprolegniaceae: J. N. COUCH.

A new species of Thraustotheca and a related Achlya: W. C. COKER.

Economic status of the forests of the southeastern United States: W. W. ASHE.

Age and structure of the North Carolina Newark (by title): COLLIER COBB.

Transportation problems in relation to our changing environment (by title): COLLIER COBB.

The breeding season of Limnoria at Beaufort, N. C. (by title): R. E. COKER.

On the curvature of manifolds: J. W. LASLEY, JR.

Aspects of constant curvature: A. HENDERSON.

A discussion of the loss of mass in the formation of helium from hydrogen: J. B. DERIEUX.

Secondary electron emission from iron and tungsten: O. STUHLMAN, JR.

Tests of results in physics teaching: C. W. EDWARDS.

Drop of potential in transformer oil: N. B. FOSTER.

What happens at absolute zero? A. H. PATTERSON.

An electrolytic interrupter: A. A. DIXON.

A standard form for the solution of problems: J. B. DERIEUX.

A review of the work on isotopes: A. A. DIXON.

The formation of layers in inorganic solutions: F. W. COOKE.

A suggestion in regard to some problems relating to the hydration of the ions: E. E. RANDOLPH.

A peculiar phenomenon of a Bunsen burner: H. B. ARBUCKLE.

Chemical industries in North Carolina: F. C. VILBRANDT.

The chlorination of juglone in hot acetic acid: A. S. WHEELER and J. L. MCEWEN.

The bromination of 2-amino-p-xylene: A. S. WHEELER and E. W. CONSTABLE.

McCrudden's volumetric method for determination of calcium compared with the Schohl and Pedley method: J. O. HALVERSON and L. M. DIXON.

A new ketone reagent: p-bromophenylsemicarbazide: A. S. WHEELER and J. A. BENDER.

The constitution of the dichlorohydroxyethylidene-bis-nitroanilines: A. S. WHEELER and S. C. SMITH.

Problems of the chemist in the textile industry: K. W. FRANKE.

A vacuum gage: M. L. HAMLIN.

A peculiar reaction between dichloroacetic acid and aromatic amines: A. S. WHEELER and S. C. SMITH.

Short addresses were also made by State Superintendent of Public Instruction E. C. Brooks, and by the president of the State Teachers Assembly, Miss Elizabeth Kelly.

BERT CUNNINGHAM,
Secretary

SCIENCE

VOL. LVIII DECEMBER 21, 1923 No. 1512

CONTENTS

SCIENCE: A Weekly Journal devoted to the Advancement of Science, edited by J. McKeen Cattell and published every Friday by

THE SCIENCE PRESS

Lancaster, Pa. Garrison, N. Y.

New York City: Grand Central Terminal.

Annual Subscription, $6.00. Single Copies, 15 Cts.

SCIENCE is the official organ of the American Association for the Advancement of Science. Information regarding membership in the association may be secured from the office of the permanent secretary, in the Smithsonian Institution Building, Washington, D. C.

Entered as second-class matter July 18, 1923, at the Post Office at Lancaster, Pa., under the Act of March 3, 1879.

THE ADMINISTRATION OF AGRICULTURAL RESEARCH[1]

THE question of the advantage of administration in connection with the prosecution of research has been much discussed in academic circles. It has often been looked upon askance in that quarter, and there has been apprehension lest the attempt to organize for research should infringe upon that freedom to investigate which is conceived to be the birthright of every pioneer research worker. President Angell referred to this in an address before this Association a few years ago when he said: "A fairly prevalent conception of research associates it with the somewhat mystical intellectual operations of the genius or 'near genius,' to tamper with which is a kind of profanation."

Such a view is based on the academic or university conception of research and relates, doubtless, to the more abstract field of inquiry in which the individual follows out his own course in the pursuit of that elusive thing, an idea. But much research at the present time is not of that personal or essentially individual type, carried out for the gratification and advancement of scholarship of the principal; it is institutional in that it is conducted by individuals associated in groups. They may work independently or in varying measure of cooperation, but they are members of an organized agency, designed to serve a particular field or purpose. Such agencies are developing rapidly. They deal quite largely with industrial or applied research, since their ultimate purpose is to solve problems or acquire information for the more immediate benefit of an industry or the public generally.

Agricultural research—using the term broadly—is the largest example of this type, and it is almost wholly supported or subsidized by public contributions. Practically all of it is organized, carried on by units constituted for the purpose by law; and, being organized, there must be administration by a responsible head. For organization and administration are twin brothers, in research as well as in industry. This condition does not interfere with the opportunity of the individual—it often contributes to it; but it does affect his relationships, and it imposes responsibility which the independent investigator does not accept.

[1] Paper presented at the Chicago convention of the Association of Land-Grant Colleges, November 14, 1923.

Of course, it is possible for administration to go too far, to be arbitrary and unreasonable, to exceed its function; but that is not the tendency at present in our agricultural institutions. Rather it may not go far enough in some cases.

A research institution is a public trust. It carries a very definite obligation, to humanity and civilization. Research is one field in which responsibility for the use made of opportunity and resources can not be shunned. It is not a private affair. It is a matter of public concern wherever it is done, for it is the means of growth of civilization and human welfare.

Perhaps the primary function of administration may be defined as making the most of the resources at hand, to the highest advantage of the field designed to be served. If it is true to those dependent upon it, it should aim to secure the maximum output for the funds used, to express the fullest use of the facilities at hand, the largest practicable return for the investment. "It is not the money itself but the skill and intelligence with which it is applied that determines the amount of service rendered." This is the business side. It is the principle of good business understandingly applied to research, but it is as different from the administration of business as research is from industry or commercial life. The attainment of success and the measure of it require scientific as well as business judgment.

The fundamental principle of administration in research has frequently been stated in the simple terms of selecting good men and giving them freedom and sustained support. To me, it is emphatically this, but something more—certainly more than a passive attitude toward their work after the group has been assembled. It implies an attitude of continued interest, of sympathy, understanding and encouragement; and it also implies expectation. The latter may show itself in a close study of the progress of the work and its competence to attain the ends sought, a questioning of whether delay or failure is due to the worker, his methods or his environment. It may lead to counsel and suggestion, or even to restraint, for the continued support of projects will usually bear relation to the degree with which expectations are being met. Even the most abstract research looks toward the completion of its project, and does not carry with it unlimited freedom to follow at random wherever interest or inclination may lead. A spirit of friendly criticism, of expectancy and the weighing of prospects, is an attribute of the keen administrator, although it may rarely come to the surface.

In such an organization as an experiment station, the selection of a working program out of the multitude of things which might be undertaken is naturally one of the large functions of administration. Otherwise, as usual, what is everybody's business is nobody's business. Someone must familiarize himself with the leading agricultural questions of the State or region, and maintain contacts with the industry as a whole. This usually centers in the director, for, although he needs the counsel of his specialists, in the last analysis he will be called upon to decide upon and to assume responsibility for the way in which the station is discharging its mission.

Theoretically the working program is a general expression of what most needs to be done to meet local needs or to advance problems of wider range. Naturally it deserves to be well studied and properly balanced. In this an advisory committee may be of much help.

It usually happens at the present time that this program is in part inherited and can only be reshaped gradually, but it is for the director to size up the various features of it, determine their adequacy and relative importance, and work out a policy for further development. For such a research institution must be constantly going forward.

One of the most difficult tasks of administration is the selection and recruiting of the staff. This is one of its largest responsibilities, so much depends upon it. It is naturally governed by the lines to be emphasized, and within these it depends on disposition to search out men and ability to judge them. The choice may be influenced by the fact that other college duties are to be involved, but even when this is the case, the representations of the director as to the necessary qualifications for research may have much weight.

It is sometimes said that the efficiency of an experiment station is the sum of the efficiency of its staff, to which should be added, in my judgment, judicious administration, for even with a highly competent staff the effectiveness with which their work is carried on will depend to no small extent upon conditions which center in the administrative office.

The fact that over half the workers in the experiment stations have other calls upon them—either teaching, extension, regulatory or service—gives opportunity for administrative attention. In a sense research has often to meet the competition of other college duties and interests, some of which are regular and imperative. Hence the necessity for insuring to the workers the necessary time for research, and avoidance of the frequent tendency of individuals to take on too many different projects. This latter needs to be guarded or it may result in good intentions degenerating into protracted routine with too little study. Opportunity is required, not only for the making of experiments, but for the exercise of the thinking function indispensable to research.

Furthermore, individual workers vary in their qualifications and experience, and they are grouped in college departments in which the research spirit

often varies. The wide range of station work, from routine determinations and observations, and the making of relatively simple tests and experiments, to the more original abstract and theoretical inquiry, affects the standards and the outlook of workers. The director may help to correct this in individual cases, and give opportunity for growth. He may supply incentive which will encourage workers to strengthen their attack and look deeper into their problems. Administration can not put into a man what is not in him, but it can stimulate his development, if the basis is there, and it may lead and help him to make better preparation and to elevate his standards. It may give him a chance, and impress upon him both his opportunity and his responsibility.

Similarly the standards and type of work of different departments may call for attention. For while departments can not expect to be self-contained it is now very evident that the fundamental research can not be done in one place or department and the applied work in another. Departments themselves may need to be strengthened. Certain ones will usually stand out more prominently in their work than others, for a symmetrical organization is rarely attainable, but the research spirit should be in evidence, with encouragement for its development as opportunity offers. Without a well-defined research policy, competent workers can not be attracted to a department; and on the other hand, ambitious investigators whose efforts are not sympathetically supported will seek other fields or lose their zeal.

In practise, administrative attention is usually needed in some directions more than in others. Different men work according to their particular aptitudes and habits. Research in the more abstract fields can not be systematized to the extent that less exacting types may be, and in large measure the investigator in that field must be free to follow his vision. Not infrequently, however, well qualified investigators respond to suggestion which directs them into channels germane to the station and the special subjects it desires to study, or prevents their wandering too far afield. Naturally, the director should come to know his men, for in a sense the freedom accorded an investigator usually will be earned.

It has been said of one of our most successful station directors, recently retired, that he performed "the difficult and delicate task of administering research in such a way as to enable his associates to put forth their best." This is one of the highest tributes that could be paid such an officer, for as another has said, "the chief problem of the research director is to maintain the freshness of view, enthusiasm and keenness of his staff."

Again, administration may insure that each undertaking is well considered at the outset, that so far as feasible it has been thought through, that its real nature and what it will likely involve have been gone into, and that if insufficient in itself it may have the support of workers in other lines. If administration does this it will lend real service, to the investigator as well as to his organization.

It is now generally conceded that owing to the complex character of problems in agriculture there is a substantial basis for cooperation. Rarely are departments sufficiently broad or complete in themselves to solve these problems in a thorough way, or to make the contributions applicable unless they are supported by the studies of other branches. The drift toward specialization emphasizes this and calls for correlation of effort and of forces. The attitude of the director can do much to develop the cooperative spirit and effect union of effort where needed.

This may seem a large program for the administrative officer. It implies that his heart and understanding are in research, and it involves the maintenance of close contacts. But the duties connected with administration do not necessarily all devolve in detail upon the administrative head. Especially in the larger stations he may so organize these as to bring to his aid committees and councils of various kinds, and supply means for keeping himself informed. These constitute the machinery of administration, and they have been found decidedly helpful in many cases. They may promote alike the spirit of unity and of individual responsibility, and cement the feeling of partnership in the carrying out of a great enterprise.

What then of the qualities of an administrative officer to discharge the functions of his important office? According to the Report of the Commission on Agricultural Research, made to this Association in 1907, "The immediate executive officer of a research agency should be a broadly trained scientist . . . whose time and thought should not be seriously absorbed by other duties. Such expert direction is essential to securing proper unity of work and the efficient coordination of the efforts of individuals." The same idea was recently expressed by the staff of a station where the position is vacant, in maintaining that the director "should be a man who through first-hand experience understands the methods and purposes of modern agricultural experiment."

To quote from a leading English authority on the subject:[2]

> The director of a research organization requires not only the qualities of a research worker, but those of an administrator. Scientific training of a high order should be combined with considerable practical experience in the industry concerned. . . . He must have a wide knowledge of men, be tactful in handling them, and able

[2] Fleming and Pearce, *Research in Industry.*

to inspire them with enthusiasm he himself must feel. He must be primarily a leader. In no way will his capacity be more demonstrated than in the manner in which he attracts and retains the services of able men.

Evidently the director of a station can not hope to be an expert in all the parts of the station's work, but he can know something about them and the elements essential to their success. In the more conventional lines of experiment, which comprise a very considerable part of the station work, he may claim some judgment regarding their competence to advance beyond a certain point, and their need for supplementing by more exact inquiry. Even in the more advanced lines, it is possible for an officer trained in science to determine whether the investigation is definitely aimed and keeping to its course, whether it is constantly constructive and not falling into an unstudied routine.

It is apparent, therefore, that the administrative officer ought not to lack for time, for his duties to his staff and to the public, the weighing and evaluation of efforts, and the maintenance of the work upon a plane adequate to the needs, will make no small demands upon him. There is danger in such an officer having too many other duties and outside interests which tax his strength and divert his attention, sometimes for protracted periods. He ought himself to be a student, with opportunity for the full play of his vision of problems and possibilities and the means of meeting them. His chief task will be to maintain the objective of the station in the largest and best sense.

This may well be his first concern at all times. A fund of a hundred thousand dollars and upwards for research, such as over half the stations enjoy, amounting to more than a quarter of a million in ten States, is no small responsibility and gives opportunity for the best thought and judgment at command. It opens the way for the highest type of administration. It calls above all for that inspirational leadership which serves to spread the "contagion of ideas."

E. W. Allen
U. S. Department of Agriculture

RESOLUTIONS ADOPTED AT THE AUSTRALIAN MEETING OF THE PACIFIC SCIENCE CONGRESS

The scientific problems of the Pacific are so numerous and varied and involve so many individuals, institutions and governments that it has been found profitable to organize conferences at which work in progress may be discussed and means and methods for further progress may be carefully considered. The probable value of such conferences was recognized by the Australian meeting of the British Association for the Advancement of Science, 1914. A conference on the Pacific, which included in its program science, history and international relations, was a feature of the Panama-Pacific Exposition at San Francisco in 1915; at the semi-centennial anniversary of the University of California in 1918 a similar conference was arranged; and the Exploration of the Pacific formed the central theme at the meeting of the Pacific Division of the American Association for the Advancement of Science in 1919.

The consideration of this subject by the National Academy of Science resulted in the establishment of the Committee on Pacific Exploration in 1915—a committee which, with changes of personnel, has become the Committee on Pacific Investigations of the National Research Council. The deliberation of this committee showed the advantages to be gained by a series of conferences which would bring together representative scientists from Pacific countries actively engaged in research. During the period of the war the scope and purpose of such conferences were discussed on the basis of extensive correspondence and in 1918–19 meetings of the Committee on Pacific Investigations resulted in arrangements for the conference which met in Honolulu, August 2–20, 1920.[1]

The Pan-Pacific Science Congress held this year in Australia had the same general function as the Honolulu conference, but was wider in scope and had a larger attendance. Its proceedings are to be published by the Australian National Research Council under whose auspices the Congress convened. By invitation of the Japanese National Research Council the Congress of 1926 will be held at Tokyo.

The scope of the Australian Congress, which was attended by delegates from Australia, British Malaya, Canada, Chile, Dutch East Indies, England, Fiji, Formosa, France, Hawaii, Holland, Hongkong, Japan, New Guinea, New Zealand, Papua, the Philippines, Scotland, Tahiti, United States, is shown by the resolutions adopted.

In selecting the resolutions for publication those primarily of local interest have been omitted, and from certain others explanatory clauses have been eliminated. The Australian Research Council has authority to revise the wording of resolutions before publication in the official proceedings of the Congress.

Organization and Future Meetings

(1) That this Congress recommends the establishment of a permanent organization of the scientific institutions and individuals engaged in research on the scientific problems of the Pacific Region.

(2) That the President of the Third Pan-Pacific Sci-

[1] Proceedings of the First Pan-Pacific Scientific Conference, Bernice P. Bishop Museum Special Publication, No. 7, Parts I, II, III, 1921.

ence Congress request the National Research Council or similar institution or agency of each of the following countries, *viz.*, Australia, Canada, Chile, France, Great Britain, Japan, Netherlands, New Zealand, the Philippine Islands and the United States of America, to appoint a member of an Organization Committee, the chairman of the Committee to be a resident of the country in which the Congress will be held, and that the Committee be empowered to add to its membership representatives from other Pacific countries.

(3) That the Organization Committee be requested to prepare a preliminary draft of a constitution and methods of procedure of the organization and to report its recommendations to the next Congress.

(4) That the National Research Council or equivalent organization of the country in which the next Pan-Pacific Science Congress is to be held be invited to appoint the President and other executive officers of the Third Pan-Pacific Science Congress and that all the executive duties in connection with that Congress be entrusted to it.

(5) That this Congress requests the Australian National Research Council to take any steps necessary to give effect to any resolutions of which Congress approves.

SECTION I. AGRICULTURE

(1) The Congress approves the appointment of a special committee consisting of five geneticists to collect information on all genetic research, now in progress in the countries bordering on the Pacific Ocean; this committee to report to the next meeting of the Congress.

(2) This Congress, realizing the great economic importance of properly conducted soil surveys, recommends to the Governments of the Pacific region that such work be pushed ahead as rapidly as possible, that the physical character of the soil and subsoil be the basis of such surveys, and that, when practicable, the character of the native flora growing on each type of soil be recorded.

(3) (Joint Recommendation from Agriculture, Entomology and Forestry Sections.) That in view of the destructive nature of several diseases of sugar-cane, introduced into Australia from New Guinea, and the possibility that the cultivation of sugar-cane in the tropics originated in that area, the Congress recommends that a survey of the diseases and insect pests of sugar-cane and their natural means of control be undertaken in New Guinea at an early date, by the Pacific countries interested in sugar-cane cultivation.

(4) Since plant diseases and insect pests cause enormous aggregate losses of crop plants, the Congress recommends: (1) That their distribution be limited as much as possible by plant quarantines; (2) That plant disease and insect pest surveys and epidemiological studies, which are prerequisite to intelligent action, be undertaken in all countries bordering on the Pacific; (3) That the results be interchanged freely.

SECTION II. ANTHROPOLOGY AND ETHNOLOGY

(1) Teaching of anthropology: The preservation, progress and welfare of the native population of Oceania, which is a charge under the terms of the Mandates granted to the Commonwealth of Australia, can best be carried out by a policy based on the investigation of native conditions, customs, laws, religion and the like, which is a study not merely of academic interest and importance, but points the way to a sympathetic method of dealing with and governing such peoples. The economic development of these countries depends largely upon the adoption of an intelligent native labor policy of recruiting, treatment, protection, and so forth, which can be built up only on a wide and sympathetic knowledge of native life and thought; this knowledge can best be gained only by intensive investigations by trained students.

The Congress, therefore, suggests that provision be made for the teaching of anthropology in the universities of Australia.

(2) Need for research in Australia and Oceania: Recognizing the necessity for the immediate prosecution of anthropological research in Australia and Oceania, this Congress calls the attention of governments, universities, patrons of research and research foundations to the pressing and important need for this investigation.

The undoubted disappearance of the native population in many areas, which not only seriously affects the labor problem, but involves the loss of most valuable scientific material, and in the territories held under mandate, is itself the most serious obstacle to the duty accepted by the mandatory powers of promoting the material and moral well-being and social progress of the inhabitants.

It is therefore urged that governments responsible for the welfare of Oceanic peoples should recognize that ethnology has a practical value in administration and is of definite economic importance, and that they should proceed without unavoidable delay to take such steps as are necessary for these purposes.

In view of the great and peculiar interest of the Australian aboriginals as representing one of the lowest types of culture available for study, of the rapid and inevitable diminution in their numbers, and of the loss of their primitive beliefs and customs when under the influence of a higher culture, the Pan-Pacific Congress urges that steps should be taken, without delay, to organize the study of those tribes that are, as yet, comparatively uninfluenced by contact with civilization.

(3) Objects of Research: The study of racial mixture is of great importance from a sociological point of view, but it is first necessary that the physical anthropology and psychology of the component races should be adequately investigated. An agreement as to procedure and standardized methods should be adopted without delay, as without these, comparisons of results by various workers are impossible.

The intensive study of limited areas, comprising all branches of anthropology, including linguistics.

The collection, translation and publication of information already on record.

One object of these and similar inquiries is to elucidate the history of Oceania, which can be accomplished by a comparative study of traditional lore, languages, beliefs and practices, and physical characters.

It is essential that anthropologists should seek the

cooperation of geologists, botanists and zoologists, since the solution of the problems of the distribution of men is largely dependent upon their aid.

For historical reasons the area that first needs study is Micronesia, since the culture and ruins of this group are of such a nature that, adequately dealt with, they should furnish the clue to much that is obscure in Oceanic mythology, folk-lore and culture generally. While Micronesia is an area of outstanding importance, other parts of Oceania should receive early attention, among them being Southern Melanesia, including New Caledonia, New Guinea, Tahiti and neighborhood, especially Raiatea, and Manu'a of Samoa.

(4) Areas of Research: The Congress is generally agreed that it is desirable for practical purposes that the investigation of various areas in Oceania should be undertaken as a whole by definite bodies.

The Pacific region may be divided into four main areas—(1) Australia, (2) New Guinea and Melanesia, (3) Polynesia, (4) Micronesia.

It is suggested: (1) That Australian ethnology be the special concern of Australia; (2) that Australia should more particularly investigate Papua, the mandated territory of New Guinea and Melanesia, but Great Britain and France should assist in this work; (3) that the investigation of the Maoris be the especial province of New Zealand (the rest of Polynesia may be regarded as preeminently the field for American research, with the cooperation of France and New Zealand); (4) that the study of Micronesia be the particular province of Japan and America.

Although Indonesia is not technically a part of the Pacific it has such close historical and cultural affinities with Oceania that a thorough investigation of this area is indispensable for a comprehensive knowledge of Oceanic problems. While recognizing what has been done by the Netherlands Indies Government the Congress hopes that this government may see its way to cooperate in the proposed scheme.

SECTION III. BOTANY

(1) It seems desirable that a complete botanical survey be made of Macquarie Island in order to obtain records of plant distribution and migration of Antarctic flora.

(2) It seems desirable that a complete botanical survey be made of the Aleutian Islands that records may be obtained of plant distribution and migration of the Arctic flora.

(3) It is recommended that the botanical surveys made of Krakatau Island be continued.

(4) It is recommended that between Congresses there be an exchange of botanical research work bearing upon the Pacific.

(5) It is recommended that museums, herbaria and research laboratories establish a system of exchange of research material bearing upon the Pacific.

(6) It is recommended that ethnological, geological and other expeditions, so far as possible, might be provided for the collection of botanical material.

(7) There is an urgent need of a bibliography of the botany of the Pacific Islands.

(8) That it be suggested to the state government of Victoria that it should reserve for all time an area or areas of land on which the tallest eucalypts now living have their stand.

(9) In view of the need for detailed information regarding native plants, it is recommended that the various herbaria and collectors be asked to use field labels similar to those used in the Philippine Islands and Dutch East Indies.

SECTION IV. ENTOMOLOGY

(1) That, in view of the danger to Australian industries from insect pests, indigenous and imported, this Congress is of the opinion that the Federal Government should set aside adequate funds for the establishment, equipment and maintenance of a Federal Bureau of Entomology for the necessary research in this connection.

(2) That the Congress urges the importance of making special provision for training in our universities economic entomologists up to the highest standard of proficiency.

SECTION V. FORESTRY

(1) That it be suggested to the Commonwealth Government to extend the scope and activities of the Institute of Science and Industry by the establishment and maintenance of an efficiently equipped Forest Products Laboratory.

(2) Having regard to the limited extent of forested land, and the prospects of a large increase in population, the importance of permanently reserving for forestry all suitable timber-bearing areas in the Commonwealth of Australia is suggested in the interests of national safety.

(3) Having regard to the approaching world's shortage of coniferous woods, it behooves all Pan-Pacific countries to give immediate attention to the subject of planting, and that this resolution be brought to the attention of the federal and state governments of the Australian Commonwealth.

SECTION VI. GEODESY AND GEOPHYSICS

(1) It is desirable that maps of Australia should be prepared on the International Scheme. In view of the advanced state of the cartography of Japan, the Netherland Indies and other countries, this work is deemed, by this Congress, to be urgent.

(2) That the various governments, which are engaged in the production of the International Map of the World on the scale 1: 1,000,000, be urged to publish, as quickly as possible, the sheets for which they are severally responsible.

(3) In the opinion of the Congress, a Geodetic Survey of Australia is an urgent necessity, alike on national economic and scientific grounds.

(4) That the Congress warmly appreciates the decision to proceed at once with the organization of the Commonwealth Solar Physics Observatory, and expresses the confident hope that the scientific results will fully recompense the Commonwealth Government for its scientific enterprise.

(5) In view of the unique opportunity for international cooperation afforded by the geographical position of the Toolangi Magnetic Observatory, and of the scarcity of magnetic observatories in the Southern Hemisphere, this Congress strongly urges that adequate provision be made by the Government of Victoria for the prompt reduction of the observations and publication of the results.

(6) That this Congress desires to place on record its appreciation of the investigations, valuable both to geophysicists and navigators, that have been carried out on the non-magnetic survey yacht "Carnegie," and expresses the hope that it will be possible to continue this work by the magnetic exploration of fresh ocean areas and by the determination of the secular variation of the magnetic elements.

(7) Understanding that the Imperial Government of Japan is considering the establishment of a geophysical and astronomical observatory on one of the Japanese mandatory islands in the Pacific, this Congress desires to express its belief in the scientific value of the scheme, and sincerely hopes that it may be carried out.

(8) That this Congress urges the speedy erection of wireless stations in all countries bordering the Pacific capable of communicating directly with each other. It is considered that practical progress in popularizing intercommunication by this means will be of great benefit in advancing the aims of the Congress for scientific unity.

(9) That this Congress recommends that arrangements be made for all wireless stations in and bordering on the Pacific to keep daily records on an approved basis with regard to static, its effect on wireless communication and its relation to meteorological conditions. That these records be compiled with a view to presenting an agreed statement of the total results at the next meeting of the Congress.

(10) That a speedier and more continuous interchange of knowledge between the nations in and bordering the Pacific will greatly aid the desired unity of scientific action, and the Congress urges each country concerned to promote research in long distance wireless telephony by giving to their individual experimenters the greatest freedom and facilities for development, having regard to non-interference with the regular transmission service.

(11) That the governments of the United States, France, Japan, Dutch East Indies, Australia and New Zealand be requested to establish a daily mean time signal and that this signal be transmitted at 8 P. M. local standard time from Tahiti, Funabashi, Cavite, Bandung, Perth, Adelaide and Melbourne, and 9 P. M. from Sydney and Wellington.

(12) That this Congress recommends that a scientific time signal be established and radiated from Honolulu consisting of 300 dots at intervals of approximately 0.98s. without any spaces; that this signal be transmitted with high power daily for about 5 minutes commencing at 1h. 01m. A. M. Greenwich Mean Time and that a circular be sent to all Pacific observatories possessing wireless facilities requesting astronomers to make the recording of coincidences a part of their daily routine and to forward results regularly to the secretary of the "Commission de l'heure" of the International Astronomical Union.

SECTION VII. GEOGRAPHY AND OCEANOGRAPHY

(1) That, whereas the Pan-Pacific Congress regards the 1: 1,000,000 map as of special value, and whereas only a few sheets of this map have been published by the countries bordering on the Pacific, the various governments which are parties to the Paris Convention of 1913 be urged to publish further maps as soon as possible.

(2) That this Congress wishes to emphasize the increasing importance of accurate coastal surveys being carried out in accordance with the recommendations of the International Hydrographic Bureau; that special attention be called to the scientific and economic interest of the construction of detailed charts of the Great Barrier Reef of Australia.

(3) That this Congress desires to call attention to the need for an adequate wireless meteorological service in the more remote parts of the Pacific Ocean and urges that the international exchange of meteorological information for the purposes of forecasting be extended to these regions.

(4) That the president of this Congress appoint a committee on the investigation of the temperature, salinity, hydrogenion concentration and currents of the Pacific Ocean, and that this committee be composed of at least one representative of each country represented at this Congress in which such investigations of the Pacific Ocean are now actively prosecuted.

(5) That this committee be requested to consider especially: (a) Data that have been accumulated on surface temperature of the Pacific Ocean and where they are deposited; (b) how these data may be made available; (c) what is the order of accuracy of the available data; (d) what improvements may be desirable in taking records of surface temperature and if improvements are needed how may they be effected; (e) types, purchase-cost, cost of installation, and cost of operation of oceanographic thermographs.

(6) That this committee be requested to take such steps as may seem appropriate to advance the study of the subjects mentioned in this motion and of cognate subjects, and that it report at the next Pan-Pacific Science Congress.

SECTION VIII. GEOLOGY

(1) That in view of the experience gained in countries in which geological surveys are well advanced this Congress records its opinion that accurate topographical and geological maps provide the most effective and economical basis for the development of the mineral resources, including ground water, of any country.

(2) That geological maps of the Pacific countries on a scale of 1: 1,000,000 be completed at as early a date as possible, and that a committee consisting of representatives of the different countries concerned be appointed to expedite this work.

(3) *Whereas*, it is felt that there are many geological problems in the Commonwealth which call for investigations in areas transgressing the boundaries of the states, there seems to be a well-established case for a Federal Geological Survey.

It is considered that such work should supplement rather than displace the geological activities of the states, and it is considered also that general geological work will be of immense value in the development of mineral resources even if not carried out directly with that object in view.

Moreover, the wise administration of the Northern Territory can be effected only with geological assistance, and the work now being carried out in Papua, excellent though it is, requires extension to a degree commensurate with the area and importance of this region. In Papua and the Northern Territory the mineral resources vest in the Commonwealth Government, and their full development demands adequate geological organizations. The Pan-Pacific Science Congress suggests that the Commonwealth Government establish a Federal Geological Survey (provided always that this proposal is approved by the state governments).

(4) That this Congress has been greatly impressed with the scientific and economic value of the results achieved in Papua by the government geologist and it expresses the hope that these investigations may receive increased support.

(5) That a geological survey of the Fiji Islands is desirable both on scientific grounds, particularly in throwing light on the origin of coral reefs and on earth movements in the Pacific Region, and because it may procure valuable information on the mineral resources of the islands and can not fail to be of great assistance in opening up the country for settlement.

(6) Since it is desirable to arrange for a more systematic treatment of the tectonic features of the Pacific Region, it is recommended that a committee composed of members from the principal countries concerned be appointed to draft an outline for papers dealing with this subject at the next Congress.

(7) That it is important to institute a series of observations in the Pacific Ocean in critical areas of crustal unrest for the accurate determination of latitude and longitude. These observations should be repeated at regular intervals, say, once in every five years, in order to ascertain what horizontal movements may be involved in such areas of instability. The selection of the localities should be done by a committee appointed by the Congress.

(8) That, in view of the importance of meteorological and seismological observations in the Pacific area, this Congress urges that the staff and equipment of the observatory at Samoa should be increased, so that it may efficiently continue the good work already begun.

(9) That in view of the scientific and economic results which would accrue from the systematic study of the thermal region of New Zealand the Pan-Pacific Science Congress strongly commends the proposal for the establishment of a seismological and volcanic observatory in that region.

(10) That it is desirable that different agencies cooperate in the study of coral reefs, and it is particularly suggested that where practicable aeroplane surveys be made.

(11) The Pan-Pacific Science Congress views with much satisfaction the establishment of the committee recently formed for the purpose of investigating the problems, both scientific and economic, of the Great Barrier Reef and heartily endorses the general plans which are being formulated for carrying out the scientific investigations.

SECTION IX. HYGIENE

That the scientific problem of the Pacific which stands first in order of urgency is the preservation of the health and life of the native races by the application of the principles of the sciences of preventive medicine and anthropology.

SECTION X. VETERINARY SCIENCE

(1) That an International Bureau of Animal Health be established; that all countries represented at the Pan-Pacific Science Congress forward to the bureau a monthly notice of all outbreaks of contagious and infectious diseases of animals and an annual report of their personnel, activities, etc.; that the bureau be a coordinating center to transmit all such information to countries represented at the Pan-Pacific Science Congress monthly and annually as the case requires.

(2) In view of the importance of the animal industries in the Pacific regions, it is recommended that greater encouragement be given to the study of animal genetics to improve the breeds of productive animals in the various countries.

(3) (In conjunction with Zoology): That this Congress expresses its appreciation of the work already done by the Commonwealth and state governments of Australia in protecting the unique native fauna of their territories; that this Congress affirms the desirability of establishing further faunal sanctuaries in Pacific countries where interesting and valuable native animals are in danger of extinction.

(4) In view of the increasing importance of the livestock industry in Papua and the Australian mandated territories, this Congress recommends that a veterinary survey of those regions be carried out by the Commonwealth Government under the direction of a veterinary bacteriologist experienced in the tropical diseases of animals.

SECTION XI. ZOOLOGY

(1) That it is desirable that investigation and survey of terrestrial and marine fauna and flora of countries in and surrounding the Pacific should be carried on through the agency of existing institutions and societies, and that for this purpose such countries should be divided into unit areas of which the Commonwealth of Australia and its territories together should constitute one.

That where this investigation is not being adequately

carried out, the National Research Council for the area be urged to initiate and further the work.

(2) *Whereas:* (1) It is certain that many economically valuable species of marine mammals such as fur seals, sea otters, whales and elephant seals and dugongs once occurred in various portions of the Pacific in such numbers as to constitute the bases of important industries; (2) extremely unwise and wasteful modes of prosecuting these industries have resulted in reducing most of these animal resources nearly to commercial extinction; (3) it is known that small remnants of many of these species still exist in widely separated regions of the Pacific; (4) there are excellent grounds, notably in the rehabilitation of the Behring Sea fur-seal herds under this protection of international treaty for believing that many of these depleted species could be restored to their former abundance by protective measures; *therefore, be it resolved:* That, with a strong belief in the possibility of securing the restoration and perpetuation of many of these useful animals, this second Pan-Pacific Science Congress recommends that: Steps be taken at once by the nations of the Pacific having interests in these species either acting independently or jointly in cases where independent action would be ineffective (a) to make a thorough scientific investigation of the present condition, the history, and the scientific and economic worth of these species with a view to such action as may be necessary to secure the desired end; and (b) to obtain such governmental measures, either by the nations concerned acting separately or jointly where necessary by international convention as would make effective the measures found essential by the scientific investigations for the protection and restoration of the depleted herds and species.

(3) (Endorsed by Geography Section.) In view of (a) the wealth of marine life, including the microplankton at one extreme and fishes and marine birds and mammals at the other, in certain portions of the Pacific Ocean; (b) the seeming barrenness of certain other parts; (c) our very imperfect knowledge of the delimitation of these areas and of the physical and other conditions which determine the fertility or otherwise of a given oceanic area; (d) the moral certainty that with the growth of population in the Pacific Region, already dense in some portions thereof, the future will be obliged to requisition these sources of organic life for food and other human needs, much more extensively than is now the case; and finally (e) the slowness and difficulty of gaining reliable knowledge in this domain of science; *therefore, be it resolved:* That the Second Pan-Pacific Science Congress urges upon the nations of the Pacific the importance of researches in all those aspects of oceanography, physical and biological, essential to an understanding of the organic productiveness of the Pacific and to the utilization and conservation of such portions of that productiveness as may be available for the needs of mankind; and further, that this Congress urges the necessity for the establishment of marine biological stations upon such portions of Pacific coasts as do not already possess them.

HERBERT E. GREGORY

THE FRIENDS OF MEDICAL PROGRESS

Two years ago the Committee for the Protection of Animal Experimentation was organized in Boston to cope with an unusual period of activity on the part of local antivivisection cults. The work of the Committee was successful. For a year or more after this emergency there was a wide correspondence and much discussion both here and with England, where a Defense of Research Society became necessary some years ago. For many years our physicians have carried on the freedom of research defence here in America purely as a civic duty and with much expenditure of time and energy and they have been far more successful than their English colleagues. Abroad they made an unfortunate compromise, with the antivivisectionists who nevertheless now cry louder than ever for the total abolition of all Animal Experimentation. Latterly these misguided cults in America have been increasing in power as their funds have gradually accumulated.

Therefore there has been an insistent and widespread demand that the work of the old Committee be given permanent form and a National Society in the control of Laymen has been organized called the Friends of Medical Progress. The purpose of this Society is not controversial but educational, along the broadest lines, and the articles of incorporation state its purposes as follows:

(1) To encourage and aid all research and humane experimentation for the advancement of medical science; (2) to inform the public of the truth concerning the value of scientific medicine to humanity and to animals; (3) to resist the efforts of the various persons and societies constantly urging legislation dangerous to the health and well-being of the American people.

The Committee did much to protect experimentation in biological laboratories and the new Society is naturally likewise committed to the same policy. The officers of the Society are:

Honorary President
CHARLES W. ELIOT
President Emeritus Harvard University

President
THOMAS BARBOUR
Museum of Comparative Zoology, Cambridge, Mass.

Secretary
EDWARD WIGGLESWORTH
Director, Boston Museum of Natural History

Treasurer and Assistant Secretary
MARY LEE THURMAN
28 Newbury St., Boston, Mass.

Field Secretary
ERNEST HAROLD BAYNES
Meriden, N. H.

The following distinguished list of Honorary Vice Presidents have consented to serve:

JAMES ROWLAND ANGELL
President of Yale University
HON. CHARLES EVANS HUGHES
Washington, D. C.
THE RIGHT REV. ALEXANDER MANN
Bishop of Pittsburgh
HIS EMINENCE, WILLIAM CARDINAL O'CONNELL
Archbishop of Boston
MISS ELLEN F. PENDLETON
President of Wellesley College
ERNEST THOMPSON SETON
Greenwich, Connecticut
OWEN WISTER
Philadelphia, Pennsylvania

The Medical Advisory Board consists of:

W. W. KEEN, M.D., *Chairman*
Philadelphia, Pennsylvania
CHARLES C. BASS, M. D.
Tulane University
MONTROSE T. BURROWS, M.D.
Washington University, St. Louis, Mo.
WALTER B. CANNON, M.D.
Harvard Medical School, Boston, Mass.
CHARLES P. EMERSON, M.D.
University of Indiana
SIMON FLEXNER, M.D.
Rockefeller Institute
WILFRED T. GRENFELL, M.D.
St. Anthony, Newfoundland
WILLIAM J. MAYO, M.D.
Rochester, Minnesota
GEORGE W. MCCOY, M.D.
Hygienic Laboratory, Washington, D. C.
HENRY SEWALL, M.D.
Denver, Colorado
H. GIDEON WELLS, M.D.
Sprague Memorial Institute, Chicago, Ill.
GEORGE H. WHIPPLE, M.D.
University of Rochester, New York
DAVID S. WHITE, M.D.
Ohio State University, Columbus, Ohio
RAY LYMAN WILBUR, M.D.
Leland Stanford University, California

During a recent address before the American Public Health Association, Dr. George E. Vincent, of the Rockefeller Foundation, stated the aims of the Society in the following terms (no better summary is possible):

What the layman needs is education in the significance of modern science and especially with regard to medical science. He is troubled by what the anti-vivisectionist says. He wonders whether all these people that he has respected and heard about are engaged in this awful torture of poor suffering creatures—wonders what it is all about. He is subjected all the time to the constant campaigns of societies that are organized to propagate these absurd notions about anti-vaccination and anti-vivisection. There is a systematic, well-organized propaganda going on in the United States, endowed and backed by large contributions from a large number of honest and fanatical people. Honest and fanatical people are the worst combination possible. You need not worry about people whose motives are bad. They usually take care of themselves, but a great mass of perfectly wrong-headed and nobly devoted people to a cause are a fearful calamity to any country, and we suffer from them.

We have all this organized wrong-headedness in this country, and it is not a thing to laugh at or despise; it is not a thing to suppose can be left alone and it will somehow burn itself out.

Therefore, I am sure that all of us have welcomed the organization of a society that frankly, systematically, intelligently and honestly proposes to enter the field to combat these dangerous ideas which are spreading and which are confusing the minds of the average layman. There has been organized the society known as the Friends of Medical Progress. The honorary president of it is that great man, that man whom we all honor and revere, that man who has been a force in American life that it is impossible to estimate, a man who in what in other men would be old age, is *still* possessed of all his vision, all his courage, idealism, all his interest in human affairs—President Eliot, of Harvard University.

This society is beginning a systematic, scrupulous, careful, thorough, scientific and conscientious campaign to educate the public of America as to the meaning of modern medicine, the meaning of modern science, the methods which modern science utilizes, what animal experimentation is. We have to call it vivisection because the people who are attacking it constantly talk of vivisection, and they say that calling it anything else is dodging the issue.

This society issues pamphlets and urges people to understand the meaning of animal experimentation, what it has done for public health and the benefit of mankind. This is a society which every member of this association ought to support, every member of this association ought to join, and it is hoped in communities all over the United States branch societies will be organized until we have a federation throughout this country of intelligent laymen keeping their heads, trying to get the right kind of information, going carefully into these things, running down rumors, having things investigated.

You know every time you have a talk about vaccination, somebody says that vaccination always results in tetanus, kills more people than it saves, and all that sort of thing. We need in every community throughout this country a group of right-minded, courageous men and women banded together to see that the American public gets the absolute truth with regard to this whole question.

So therefore the Society of Friends of Medical Progress has been founded because there is an or-

ganised, widespread and dangerous movement on foot to discredit the medical profession, to procure legislation which will prevent the progress of medicine and surgery, to break down the bulwarks of preventive medicine, and thus expose our people to the attacks of diseases which are now held in check by science, but which formerly took frightful toll of human life. This anti-medical campaign is being conducted by a considerable number of organizations professing various aims, such as antivivisection, antivaccination and "medical liberty," but all seeking by fair means or foul to bring into disrepute scientific methods of combating disease, and to substitute therefor every known form of pseudo-science and quackery.

The present headquarters of the Society are at 28 Newbury Street, Boston, Mass., in the house of The American Academy of Arts and Sciences by kind permission. The Society has a large quantity of educational literature available for distribution and sincerely hopes that every layman as well as every medical and biological investigator in America who may read this announcement will correspond with Miss Mary Lee Thurman, 28 Newbury Street, Boston, Mass., with a view to becoming a member of the Society and not only this but that they will give the Society whole hearted encouragement and support.

THOMAS BARBOUR

JOHN THOMAS GULICK, MISSIONARY AND DARWINIAN

JOHN THOMAS GULICK, son of a missionary, was born in Hawaii in 1832, and died recently in Honolulu at the age of ninety years. He has been widely and very favorably known as a student of the land snails of Hawaii (*Achatinellidae*), and of the lessons in evolution to be derived from their nature and distribution. He was greatly impressed, seventy years ago, with Darwin's account in "The Voyage of the Beagle," of the birds and reptiles of the Galapagos Islands, and the suggestion of localization as a moulder and determinant of forms. He found conditions even more striking existing in Hawaii. The many species of land snails on those islands occupy each a restricted area separated by barriers of stream or meadow which these slow-moving creatures practically never crossed. As he recorded the multitude of forms, the conviction grew with him that the relation of these geminate species of shells "was a marvelous self-revelation from the hand of the Creator himself and that if we could but learn the alphabet we might read from them the story of His method of creation."

Dr. Gulick, a graduate of Williams College (1859), spent most of his life as a missionary in China and Japan. Even before he had read "the Origin of Species" he had reached the conclusion that "many genuine species had been derived from descent from one original stock or species." To find out the range of this possibility and how it came about he devoted his spare time for many years. His first paper: "The Variation of Species as related to their Geographical Distribution," was published in *Nature* in 1872. Numerous other papers on the formation of species through isolation and segregation followed, the most extensive being a volume, "Evolution, Racial and Habitual," issued by the Carnegie Institution.

Nearly all Dr. Gulick's scientific work relates to the multitude of genera and species of these tree snails of a family peculiar to small groves and thickets. No one considering the wealth of illustration given by Dr. Gulick can fail to recognize that isolation has been the immediate occasion of the moulding of each of the various forms; and while the evidence in most other groups of plants and animals is not so clearly visible, every competent field-worker finds the same factor in the origin of practically every species whatever. Adaptation is produced by Natural Selection: the final differential moulding by isolation and segregation.

In the details of his work Dr. Gulick was far ahead of his time, not many laps indeed behind Darwin, and in general conception of methods of evolution he is still in advance of many able workers who are prone to forget what they have not themselves seen. The internal factors in evolution, heredity and variation, are recognized by all authors. The external factor, selection, has been fully illustrated by Darwin, and can apparently be questioned only through ignorance or perversity. Another external influence, isolation with segregation, was regarded by Darwin as a feature of natural selection, its vital importance being overlooked by naturalists who have not studied wild life in nature's own workshops.

It is worth noting in these days of conflicts between knowledge and prejudice that Dr. Gulick was a thoroughgoing Darwinian, as well as a Christian missionary. His scientific studies were to him a reverent duty, a study of the actual ways of the Creator in His actual handiwork.

Dr. Gulick, after a happy and successful life, attained a happy old age. One of the red-letter days of the present writer was in 1922, when he received an invitation to Gulick's charming home in Honolulu, where, himself a champion of *"räumliche Sonderung"* as a necessary factor in evolution, he was privileged to stand by Gulick's side when one who had studied with both of us took our photograph together.

DAVID STARR JORDAN

SCIENTIFIC EVENTS

INTERNATIONAL PATENTS

It is announced in *Nature* that the council of the Trade Marks, Patents and Designs Federation, Ltd., recently circulated a questionnaire in relation to trade marks, patents and designs prepared by the International Chamber of Commerce to a number of societies interested in these matters. This questionnaire was drawn up with the object of ascertaining the directions in which modifications and amendments were desirable, from the British point of view, in the International Convention for the Protection of Industrial Property, signed at Washington on June 2, 1911. A meeting of the representatives of some twenty of the societies consulted was held at Lever House, Blackfriars, on November 23.

The questionnaire was discussed, and it was recommended, *inter alia*, that (1) a clause should be inserted in the convention abolishing revocation of patent rights either for non-working or for abuse of monopoly, but permitting each country at its discretion to grant compulsory licenses in such cases; (2) provision should be made for establishing in all convention countries a uniform period of duration for patents, and renewal fees should be paid at agreed intervals of time and be based on a sliding scale system of progressively increasing payments; (3) there should be uniform provisions governing the use of an invention on vessels sailing under the flag of one of the states which has adhered to the convention; (4) there should be provision for registration in a public register kept by the competent administration of each country of all assignments and licenses affecting the legal proprietorship of patent rights; (5) steps should be taken to secure a greater degree of uniformity in the regulations at present in force in the various convention countries with respect to the procedure to be followed on applications for the grant of letters patent. It was further agreed that it was neither desirable nor practicable to insist upon the institution in all convention countries of a system of preliminary search of patent applications, but it was desirable that any party interested should have the right, prior to the grant of any patent, to institute opposition proceedings based on all prior publications or public users of the invention.

THE MORTALITY FROM TUBERCULOSIS AND CANCER

The Department of Commerce announces that compilations made by the Bureau of the Census show that 90,452 deaths were due to tuberculosis in the registration area of the United States in 1922, with a death rate of 97 per 100,000 population. This is a drop of 2.4 since 1921, in which year the rate was 99.4. Though 12 states show increases in rates for 1922, in 22 states there are decreases, indicating that the general trend is still downward.

To permit better interstate comparisons for the year 1922, adjusted rates based on the standard million population have been calculated. The highest adjusted rate from tuberculosis for 1922 is 172.6 per 100,000 population for Colorado and the lowest is 36.1 for the adjoining state of Nebraska. The high rate for Colorado should not be ascribed to unhealthfulness of climate, but rather to the fact that the climate attracts those afflicted with tuberculosis.

For certain states adjusted rates have been calculated separately for the white and colored populations. In this group of states Tennessee has the highest adjusted rates for both white and colored (respectively, 121.8 and 299.8 per 100,000 population). The lowest adjusted rate from tuberculosis for white population is 54.5 for Mississippi and this State and Florida each shows the lowest rate for colored population (171.5 per 100,000 population).

Cancer caused 80,938 deaths in the death registration area in 1922, which comprised about 85.3 per cent. of the total population of the United States, and if the rest of the United States had as many deaths from this cause in proportion to the population the total number of deaths from cancer in the entire United States was 95,000 for 1922, against a corresponding estimate of 93,000 for 1921.

The death rate from cancer in the registration area in 1922 was 86.8 per 100,000 population as against 86 in 1921. Only five states show lower rates for 1922 than for 1921. In comparing the death rate from cancer in one state with that in another, the bureau uses "adjusted" rates in order to make allowance for differences in the age and sex distribution of the population, because, generally speaking, only persons in middle life and old age have cancer, so that a state with many old persons may be expected to have more deaths from cancer than a state with comparatively few old persons.

The highest adjusted cancer rate for 1922 is 106.9 per 100,000 population for the state of Rhode Island and the lowest is 53.1 for Tennessee. For a few states adjusted rates have been calculated separately for the white and colored populations. In this group of states the highest adjusted rate for the white population is 92.5 per 100,000 for Maryland and the highest for the colored population is 81.7 also for Maryland. The lowest adjusted rate for white population is 52.8 for Tennessee and the lowest rate for the colored population is 40.8 for Florida.

TRANSPORTATION INSTITUTE LECTURES

ONE of the projects of the National Transportation Institute has been made an actuality by the starting of the institute's lecture course on transportation. The course is to be given by leading educators at colleges and universities throughout the country. The program was inaugurated by the giving of the first lecture at Fairmount College, Wichita, Kans., by Carleton B. Hutchings, secretary of the institute. The second lecture at Fairmount College was by Professor Arthur H. Blanchard, professor of highway engineering and highway transport at the University of Michigan. The third lecture at Fairmount was by Professor Charles L. Raper, dean of the College of Business Administration of Syracuse University.

These short courses of lectures are scheduled already at sixteen colleges and universities in the Middle West, and are being arranged at other institutions. Colleges that have arranged for lecture courses include: Fairmount College, Wichita, Kans.; Ottawa University, Ottawa, Kans.; Kansas Agricultural College, Manhattan, Kans.; Bethany College, Lindsborg, Kans.; Cornell College, Mt. Vernon, Ia.; Coe College, Cedar Rapids, Ia.; Simpson College, Indianola, Ia.; Grinnell College, Grinnell, Ia.; Penn College, Oskaloosa, Ia.; University of Detroit, Detroit, Mich.; Albion College, Albion, Mich.; Hillsdale College, Hillsdale, Mich.; Kalamazoo College, Kalamazoo, Mich.; Adrian College, Adrian, Mich.; Alma College, Alma, Mich.

University professors of transportation and nationally known authorities on economics have joined with the institute to give the courses. Those already engaged in the work, besides Professor Blanchard and Professor Raper, include: Professor Frank H. Dixon, professor of economics and social institutions, Princeton University; Professor G. W. Dyer, professor of sociology, Vanderbilt University, Nashville, Tenn.; Dr. David Friday, director of research, National Transportation Institute, former president Michigan Agricultural College; Professor Emory R. Johnson, professor of transportation, University of Pennsylvania; Professor H. G. Moulton, director, Institute of Economics, Washington, D. C.; Professor C. O. Ruggles, professor of transportation and public utilities, Ohio State University; Professor T. W. Van Metre, professor of transportation, Columbia University, and Professor Harold Whitehead, Boston University.

POWER SURVEY OF PENNSYLVANIA

As a commission from Governor Gifford Pinchot a power survey of the state of Pennsylvania has been instituted by the commercial engineering department of the Carnegie Institute of Technology. Dr. W. F. Rittman, head of the department, and Professor Sumner B. Ely are making the survey under the directorship of Morris L. Cooke, of Philadelphia.

The purpose of the study is to determine the approximate consumption of horse power necessary to operate Pennsylvania industries over a given period of future years. In order to make such an estimate possible, the engineers of the Carnegie Institute of Technology have been asked to survey the total consumption of power used in the state industries in the past twenty years.

An important possibility coming from the survey concerns the conservation of power and energy in the operation of the state industries. The need of power conservation, either through drastic curtailment of energy or by methods of distribution to the points most needed, is receiving serious consideration by the U. S. government, and by many state engineering departments. In Pennsylvania, power conservation is considered to be even more serious than elsewhere because of the tremendous consumption of energy in the Pittsburgh District.

Because of the relative importance of the state survey, Dr. Rittman and Professor Ely have been assured of the utmost cooperation by engineers and heads of industries throughout the commonwealth. They have completed a power survey of the Pittsburgh District upon their own initiative, and will have the information derived from this study at their disposal. It is planned to complete the survey by the end of summer of 1924.

Governor Pinchot's faith in the possibilities of a power survey of the state is expressed in the following statement:

> In an advancing social order, power must be both cheap and plentiful. Therefore every possible economy must be practiced. This implies the conception of a state-wide (and ultimately a nation-wide) reservoir or pool of power into which we may pour energy from whatever source, and from which storage we may take out energy to meet widely diversified scattered needs.
>
> Giant power means cutting out waste. The burning of raw coal in power plants and on our railroads has come to be recognized as waste, involving as it does the loss of by-products, such as ammonia, needed for fertilizer on the farm; tar for road-building, and other hydrocarbons useful as dyestuffs and otherwise in the industries. If these economies can be realized through building large scale by-product distillation and power plants at the mines, it will mean cheaper power because of the reduction in the cost of fuel, which to-day constitutes upward of three quarters of the whole cost of steam-developed electric current. Such giant power plants will accomplish the further economy of utilizing the coal near the mines, and thereby releasing all facilities for other purposes.

THE HISTORY OF SCIENCE SECTION OF THE AMERICAN ASSOCIATION

ON Saturday, December 29, at 10 o'clock, the first session of the History of Science Section will take place, with Dr. Florian Cajori, of the University of California, as chairman.

I. History of Early American Astronomical Observatories (Illustrated).
Dr. W. CARL RUFUS, University of Michigan.

II. The Early History of Terrestrial Magnetism and the Work of John Locke of Cincinnati (Illustrated).
DR. LOUIS A. BAUER, Department of Terrestrial Magnetism, Carnegie Institution of Washington.

III. The Historical and Practical Aspect of Meteorology, especially the work of Cleveland Abbe, and the United States Weather Bureau (Illustrated).
DR. W. J. HUMPHREYS, U. S. Weather Bureau, Washington, D. C.

IV. Uniformity of Mathematical Notation in the Light of History. Retiring Address as Chairman and Vice-President for the Section.
DR. FLORIAN CAJORI, University of California.

V. Drawing Instruments of Two Hundred Years Ago (Illustrated).
PROFESSOR EDWIN W. SCHREIBER, Proviso Township High School, Ill.

On the afternoon of Monday, December 31, a joint meeting of the History of Science and the Philological Sections will take place. This meeting will be in the nature of a symposium and an informal recognition of the 300th anniversary of Lord Francis Bacon's publication of "Novum Organum." The importance of this meeting will be to point out that the philosophy of science had its origin in the inductive methods of Bacon.

I. The Historical Setting of the Work of Francis Bacon.
DR. HARRY E. BARNES, Smith College.

II. Bacon the Founder of Modern Research.
PROFESSOR MARK H. LIDDELL, Purdue University.

III. Baconian Methods of Scientific Research.
DR. FLORIAN CAJORI, University of California.

IV. Knowledge is Power.
DR. W. A. CROWLEY, University of Cincinnati.

V. Discussion.

FREDERICK E. BRASCH,
Secretary

THE MEDICAL SCIENCES AT CINCINNATI

SECTION N, Medical Sciences, of the American Association for the Advancement of Science, will meet at the University of Cincinnati, December 29, under the chairmanship of Professor Richard P. Strong, of Harvard University. The morning session is to be devoted to a discussion of the interrelated problems of the medical worker, the parasitologist, the medical entomologist, etc.

1. Professor Francis W. Peabody, Harvard University, will speak on the rôle of Section N.
2. Dr. L. O. Howard, U. S. Bureau of Entomology, "Notes on medical entomology," which will include his recent studies in the European stations of tropical diseases.
3. Professor Richard P. Strong, director of Tropical Diseases, Harvard University, "Relationship of certain parasitic infections of plants to animals." This paper will include his recent studies in Central and South America.
4. Professor Henry B. Ward, of the University of Illinois, will discuss the problem from the point of view of the parasitologist.

The afternoon session will be devoted to a discussion of the endocrines.

1. Professor George W. Crile, Western Reserve University, will speak on "Endocrinology" from the point of view of the surgeon.
2. Professor R. G. Hoskins, Ohio State University, from the point of view of the physiologist.
3. Professor Thomas R. Sprunt, the Johns Hopkins University, from the point of view of the internist.
4. Professor J. J. R. Macleod, University of Toronto, on "Insulin."

On this Seventy-fifth Anniversary of the founding of the association the speakers will also review the historical developments of each of their sciences. All interested workers are invited.

W. J. GOLDFARB,
Secretary

SCIENTIFIC NOTES AND NEWS

THE Section of Geology and Geography of the American Association for the Advancement of Science has made arrangements to celebrate, at Cincinnati, the seventy-fifth anniversary of the association, in the foundation of which the earlier geologists played so prominent a part. The section has secured the consent of Professor T. C. Chamberlin, who recently celebrated his eightieth birthday, to speak on the subject "Seventy-five years of American Geology." Professor William Morris Davis, of Harvard University, will give an address on "The Development of Geography in the United States" and Professor H. L. Fairchild, of the University of Rochester, will speak on some of the early geologists.

THE Association of American Geographers will hold its twentieth annual meeting at Cincinnati from December 27 to 29. On the evening of December 28,

Dr. Ellsworth Huntington will deliver his presidential address on the "Materials for human geography, as illustrated in Japan, Java and Australia."

The American Society of Zoologists will meet at Cincinnati from December 27 to 29, with its annual dinner Friday evening. Professors N. K. Koltzoff and P. P. Lazareff, of Moscow, will be guests of the society and will give addresses. Saturday afternoon will be devoted to a joint symposium with the botanists and the naturalists on "Morphogenesis." Professors C. M. Child, R. S. Lillie, A. H. Reginald Buller and R. A. Harper will speak.

The Genetics program at the joint Genetics Sections of the American Society of Zoologists and the Botanical Society of America, meeting with the American Association for the Advancement of Science, at Cincinnati, has been arranged in three sessions to be held on Thursday and Friday, December 27 and 28. Titles of 22 papers on botanical subjects have been listed for the Thursday morning and afternoon sessions. Seventeen papers on zoological subjects will be given Friday morning.

The Geological Society of America meets at Washington from December 27 to 29 under the presidency of Dr. David White. Meeting with the society are the Paleontological Society of America, Dr. T. W. Vaughan, president, and the Mineralogical Society of America, Edgar T. Wherry, president.

The American Anthropological Association, of which Dr. Walter Hough is president, meets in New York City on December 27 and 28.

The American Psychological Association meets at Madison, Wisconsin, under the presidency of Professor Lewis M. Terman, of Stanford University, on December 27, 28 and 29.

The American Astronomical Society, of which Dr. W. W. Campbell is president, meets at Poughkeepsie from December 27 to 29.

The American Mathematical Society, of which Professor Oswald Veblen, of Princeton University, is president, meets in New York on December 27, 28 and 29. The Chicago section of the association and the Mathematical Association of America, of which Professor R. D. Carmichael is president, meets at Cincinnati in affiliation with the American Association.

The Federation of Biological Societies meets at St. Louis on December 27, 28 and 29.

Professor Solon Irving Bailey, senior member of the staff of the Harvard College Observatory and Phillips professor of astronomy at Harvard since 1912, who has been in charge of the station at Arequipa, Peru, for the last two years, has been given the degree of doctor of science by the University of San Augustin at Arequipa, Peru, and at the same time was made honorary professor of astronomy at the university.

The degree of master of arts, *honoris causa,* is to be conferred by the University of Cambridge on Mr. J. B. Buxton, professor of animal pathology.

Professor Arnold Theiler, director of the Bacteriological Institute of Pretoria, has been made a doctor of philosophy, *honoris causa,* by the University of Berne.

Professors A. Kneser, of the University of Breslau, and E. Study, of the University of Bonn, mathematicians, have been elected corresponding members of the Prussian Academy of Sciences.

The title of emeritus professor has been conferred by the University of Leeds on Dr. Arthur Smithells, who recently retired from the chair of chemistry, on the grounds of intellectual distinction and of long and meritorious service to the university.

Dr. F. N. Cole, professor of mathematics in Columbia University, has been granted leave of absence for the second half of the present academic year.

Paul F. Clark, Ph.D., professor of medical bacteriology at the University of Wisconsin, has returned from a semester's leave of absence. Dr. Clark served as delegate at the Pasteur centenary in Paris.

Dr. Jan Metzelaar, formerly fisheries instructor for the Dutch Government, has been appointed fisheries expert for the department of conservation of the State of Michigan. His headquarters will be at the Museum of Zoology, University of Michigan.

Bernhardt G. Hartmann has been transferred from the Chicago Food and Drug Inspection Station of the Bureau of Chemistry to the Food Control Laboratory, Bureau of Chemistry, Washington, D. C.

J. E. Underwood has resigned his position as research chemist with the Radium Emanation Corporation, to join the staff of the National Lime Association as assistant chemical directors.

F. Hazlewood has resigned from the ceramics section of the U. S. Bureau of Standards, Washington, D. C., to accept a position with the Buffalo Pottery Co., Buffalo, N. Y.

Professor Alexander Mair, of the University of Liverpool, has been elected president and Dr. Betts Taplin vice-president of the newly organized Liverpool Psychological Society.

At a meeting of the New York Academy of Medicine on December 6, the following officers were elected: vice-president, three years, Dr. Herbert S.

Carter; corresponding secretary, three years, Dr. D. Bryson Delavan; treasurer, three years. The president is elected for a two-year term; Dr. George David Stewart continues to hold this office.

AT the annual meeting of the Institute of Chemical Engineers, held in Washington on December 5, 6 and 7, the following officers were elected: Dr. Charles L. Reese, chemical director of the du Pont Company, president, to succeed Dr. Henry Howard, who had completed his second term. H. K. Moore, of the Brown Co., Berlin, N. H., automatically became first vice-president and Dr. H. S. Miner, of the Welsbach Co., became second vice-president. The office of third vice-president is filled by election and Professor A. H. White, of the University of Michigan, was chosen for this office. Other officers were elected as follows: J. C. Olsen, *secretary*; F. W. Frerichs, *treasurer*; David Wesson, *auditor*; W. L. Badger, F. A. Lidbury and A. E. Marshall, *directors*.

OFFICERS of the Optical Society of America for 1924–1925 have been elected as follows: *President*, Herbert E. Ives, New York; *Vice-President*, W. E. Forsythe, Nela Research Laboratories, Cleveland; *Secretary*, Irwin G. Priest, Bureau of Standards, Washington; *Treasurer*, Adolph Lomb, Bausch and Lomb Optical Company, Rochester; *Members of the Executive Council, Ex officio*, the above officers and the past president, Leonard T. Troland, Harvard University, the editor-in-chief of the journal, Paul D. Foote, Bureau of Standards, the assistant editor-in-chief and business manager of the journal, F. K. Richtmyer, Cornell University; *Elected*, K. T. Compton, Princeton University; Carl W. Keuffel, Keuffel and Esser; P. G. Nutting, Schenectady, and F. E. Wright, Carnegie Geophysical Laboratory.

ROBERT AMORY, president of the National Association of Cotton Manufacturers and Mr. H. C. Meserve, secretary of that organization, recently delivered lectures at Princeton University on the cotton industry and its development. The lectures were delivered under the Cyrus Fogg Brackett Lectureship in applied engineering technology. Among the lecturers of the past two years in this foundation are Samuel Insull, of Chicago; John A. Britton, of San Francisco; J. W. Lieb, of New York; Ralph Modjeski, of Philadelphia, and William S. Lee, of Charlotte, N. C.

AT a meeting of the New York Section of the Illuminating Engineering Society, on December 13, Mr. Lawrence A. Hawkins, engineer of the Research Laboratory of General Electric Company, presented a paper entitled "The light of knowledge and the knowledge of light."

PROFESSOR GEORGE GRANT MACCURDY, of Yale University, was the speaker at the meeting of the Galton Society, held on December 5 at the American Museum of Natural History, New York, his subject being "Nature as reflected in Paleolithic Art."

DR. I. NEWTON KUGELMASS, of Yale Medical School, addressed the Bio Club of the College of the City of New York on November 8 on "The Relations of Colloid Chemistry to Medicine." On December 20, Dr. L. I. Dublin, statistician of the Metropolitan Life Insurance Company, will address the club on the problem of "Longevity."

THE Pasteur Lecture was delivered by Dr. Otto Folin, of Harvard University Medical School, Boston, on November 23, before the Institute of Medicine of Chicago. His subject was "What we have learned about uric acid."

PROFESSOR FRANCIS E. LLOYD, of McGill University, lectured on the subject "Fluorescence in plants" before the Royal Canadian Institute, on December 1. He will deliver a lecture on the same subject at the University of Kentucky, Louisville, Ky., on January 3 next.

DR. JOHN MAXSON STILLMAN, emeritus professor of chemistry at Stanford University, died on December 13, aged seventy-one years.

UNIVERSITY AND EDUCATIONAL NOTES

MRS. MARY COUTS BURNETT has conveyed to the Texas Christian University of Fort Worth, Texas, an estate valued at $4,000,000 and $150,000 in cash. Under the terms of the deed of trust three fourths of the annual income goes to Mrs. Burnett during her lifetime.

THE Education Research Committee of the Commonwealth Fund has made to the University of Chicago an appropriation of $14,000 to enable Director Charles Hubbard Judd, of the School of Education, and Associate Professor Guy T. Buswell, to make a study of methods of teaching arithmetic, similar to studies which recently have been made in reference to reading.

DR. JAMES M. SHERMAN, bacteriologist in the Research Laboratories of the Dairy Division, U. S. Department of Agriculture, has been appointed head of the Department of Dairy Industry at Cornell University.

DR. IRWIN ROMAN, of Northwestern University, has been appointed associate professor of mathematics at Vanderbilt University.

PROFESSOR J. C. MANRY has returned to Ewing Christian College, Allahabad, India, after completing his work for the doctor's degree in psychology at the University of Iowa. Dr. Herbert G. Kribs, late of

the department of zoology of the University of Pennsylvania, has joined the same institution as professor of zoology. Walter D. Kline, Ph.D. (Yale, '23) becomes professor of chemistry.

Professor E. Strömgren, of the University of Copenhagen, has been called to a professorship of theoretical astronomy at the University of Berlin.

Dr. G. Hergoltz, of the University of Leipzig, has been called to a professorship of mathematics at the University of Munich.

DISCUSSION AND CORRESPONDENCE

HAEMATOXYLIN

Haematoxylin is a natural dye found in logwood, and requires only to be extracted with ether and water and then crystallized. There are, of course, details of manufacture requiring attention but the method is simple and there is no difficulty in obtaining a pure product. In view of this fact it is surprising that there should have been so much trouble in getting from American sources a haematoxylin comparable with the one commonly in use at the time the foreign supply was cut off by the war. The miserable black logwood extracts that were then sold as haematoxylin were an abomination to microscopists. Failing to secure any decent material on the market, I undertook to make haematoxylin from the logwood chips and found no difficulty in doing so. Later, there appeared for sale by a number of dealers a product called "white crystals" and this has proved to be generally satisfactory. It now appears that the source of practically all this supply is the firm of McAndrews & Forbes Company, of Camden, N. J. A description of the method employed by them for the preparation of haematoxylin from logwood extract appeared in the *Journal of Industrial and Engineering Chemistry* of February, 1920.

Complaints having come to the Committee on the Standardization of Biological Stains that solutions of the white crystals did not keep well, the chairman, Dr. Conn, asked me to investigate the matter. Accordingly, with the help of Dr. Carothers, I undertook a study of a series of products which had been submitted for trial. Later I got directly in touch with the manufacturers and from them received samples of the material at different stages of manufacture and under different treatment.

As a result of all this it was learned that the "white crystals" produced to meet the demand for something different from the black crystals (?) previously on the market, owe their absence of color to the use of sulphur dioxide. In some way this agent renders the haematoxylin less stable and solutions made up with heat become very dark and stain a rusty brown without selectivity. Apparently also it is responsible for the poor keeping quality of solutions. The manufacturers, upon learning these facts, discontinued the use of sulphur and now market their product as crystals of a light brown color, similar to those of the imported substance. It is now possible, therefore, to secure in this country an entirely satisfactory haematoxylin, which can be used for the finest cytological work by the iron-haematoxylin method. This has been compared with recently imported haematoxylin and found in every way as satisfactory.

In the investigation of the various haematoxylins submitted a number of facts appeared which are of value in cytological technique. It was found, for example, that the color of a given sample might be entirely satisfactory and yet its selectivity be almost entirely lacking. Again one sample might produce a hard, sharp, vigorous coloration while another was weak and indefinite. Of course, it is possible to modify, or even reverse, the staining reaction, as I have previously announced, by incomplete removal of Flemming's fluid, but in the present series of experiments this factor did not enter.

Just what is the cause of these variations in staining reaction is not clear, but having noted certain peculiarities in the operation of the cruder samples and having observed the somewhat turbid character of their solutions, I added a small quantity of lead acetate to them. The result was to greatly improve the vigor and selectivity of the stain. I am inclined, therefore, to recommend the following procedure in cases where satisfactory results are not obtained by the iron-haematoxylin method: To 100 cc of one half per cent. haematoxylin add about three drops of a saturated solution of lead acetate and shake. The solution will become very dark but upon standing for a number of hours a fine black precipitate will form. When this is filtered out a bright clear liquid will remain. This should then give a satisfactory stain.

A good object upon which to try out the stain is a root tip section. Here it is desirable to have the chromatin stain a good vigorous black and yet without such density as to obscure the finer internal structure of prophase and telophase stages. The nucleolus at the same time should stain like the chromatin and should not, on the one hand bleach out entirely or on the other remain a dense black. All outlines should be clear and sharp in the nuclear structures without gradation into the ground substance. The cytoplasm should be light gray in color and clear and transparent. These are conditions which manifest themselves in Podophyllum root tips after fixation in Flemming's strong fluid.

C. E. McClung

University of Pennsylvania

FISHES FALLEN FROM THE SKY

THE ichthyologist of the American Museum of Natural History, Dr. E. W. Gudger, in his most interesting paper "Rains of Fishes,"[1] has grouped together many astonishing accounts of fishes falling from the sky. I wish to add some data on my own experiences with this subject.

The Yukaghir, living on the Siberian tundra between the Kolyma and Alaseyă rivers, told me that the sky, regarded by them as a beneficent deity, to supply men with food flings fishes to the earth. When fish appear in the lakes in great numbers, the Yukaghir say that they have fallen from heaven. They know well enough that fish develop from spawning, but they say that fish originally had been and continue to be sent by the deity. When asked how they knew fish fall from the sky, the Yukaghir asserted that they often found living pike (*Esox lucius*) and a river species of salmonidae, called cheer (*Coregonus nasutus*), in dry places. Evidently, said the Yukaghir, it followed that these fish in falling from heaven failed to reach the water. I explain this phenomenon in the following way: The majority of polar lakes are connected by small rivulets which the fish follow when passing from one lake to another for spawning. In the course of the passage the fish jump over obstructions formed by stones and grass hillocks. In the summer when the rivulets run completely dry in places, the migrating fish may find themselves caught on dry land.

I wish to refer to another phenomenon connected with the above belief of the Yukaghir. When some tundra lakes during a rough and snowless winter freeze to the bottom, the fish die and in the spring rise to the surface. But the lake-fauna recovers soon and new fishes appear. Without any doubt, this phenomenon may be explained by what is known as anabiosis: some frozen fishes may come to life again after thawing, or by the appearance of new fishes from other lakes through the connecting rivulets. But the Yukaghir in such cases said that the new fishes fell from the sky.

I wish to mention here another phenomenon of this kind, although it has entirely different origin and causation. While spending the winter of 1909–1910 on Umnak Island of the Aleutian Chain I experienced volcanic shocks several times. Once I was awakened in the night by a particular subterranean noise and tremor of the earth; the floor of my log cabin shook. In the morning the shore was covered with a layer of stunned fish, sea-urchins and shell-fish about two feet high and two feet wide, but in several days these were carried to the neighboring hills and eaten by gulls and ravens. The presence of shells of echini and mollusca on the hills may lead some traveler to the deceptive idea that the hills were formerly the sea bottom.

WALDEMAR JOCHELSON

NEW YORK, N. Y.

[1] *Natural History*, Journal of the A. M. of N. H., Vol. XXI, Nov.–Dec., 1921, No. 6, p. 637.

EINSTEIN AND SOLDNER

IN your issue of August 31 (1923), pp. 161–163, Dr. Robert Trumpler has explained Soldner's method of calculating the deflection of light passing near the sun and has called attention to the error in Soldner's work which had been pointed out by Lenard. In accordance with the Newtonian theory of gravitation a particle moving from infinity with the velocity of light c describes a hyperbola and the angle between the asymptotes is the deflection. From this theory it follows that the velocity *increases* as the particle approaches the sun; in fact, $v = c(1 + \gamma M/c^2r$ approximately.

In his 1911 paper Einstein discussed the effect of a Newtonian gravitational field on a clock and came to the conclusion that a clock is slowed down as it approaches matter; in particular a clock at the distance r from the gravitating mass goes $(1 - \gamma M/c^2r)$ times as fast as at infinity. If it is assumed further that the velocity of light is c at any point when measured in a suitable local coordinate system, then its velocity as measured in a natural system is $c(1 - \gamma M/c^2r)$. Hence the velocity of the light from a star *decreases* as it approaches the sun. Einstein then makes use of Huyghens's principle to determine the deflection. Thus he uses the wave-theory of light, and not the corpuscular theory, as some of his critics contend. Einstein's 1911 theory is Newtonian in that he uses the Newtonian gravitational potential, but it is not Newtonian in the sense of Soldner. In his general theory of relativity the velocity is $c(1 - 2\gamma M/c^2r)$, which accounts for double the deflection previously found. But here again the velocity decreases as the light approaches the sun and Einstein uses the wave-theory of light to calculate the deflection.

Dr. Trumpler called attention to the fact that Einstein used a different method from Soldner, but he overlooked the essential distinction between the two methods as is shown by his statement: "The fundamental assumptions on which Soldner's work is based are equivalent, as far as the present problem is concerned, to those of Einstein's 1911 paper, and Einstein's 1911 results must be and are in agreement with those of Soldner (after correcting Soldner's mistake)." They are so far as the amount of the deflection is concerned, but not otherwise. Consequently, Captain See's criticism published in SCIENCE for November 9 (1923), p. 372, is not valid, when the

distinction between the two methods is fully appreciated.

L. P. EISENHART

PRINCETON UNIVERSITY

QUOTATIONS

CONFIRMATION OF THE EINSTEIN THEORY

EINSTEIN'S theory of relativity has aroused such widespread attention that it may interest your readers to repeat in your columns an announcement which has already appeared in the scientific press.

It will be remembered that Einstein suggested three crucial tests of his theory, which experience could make. The first concerned the movement of the planet Mercury, and had already been satisfactorily made. The second could be made at a total eclipse of the sun, and concerned the bending of light rays from a star; at the eclipse of 1919 the English astronomers obtained a clear answer in favor of the theory, very satisfactorily confirmed by the American observers in 1922. The third test concerned the apparent length of the waves of light as affected by gravitation.

In this third case experiment gave at first very dubious results, some observers even declaring against the effect suggested by the theory. Moreover, some mathematicians challenged the correctness of the inference from the theory, though Einstein never wavered in his declaration that it was a necessary inference. These clouds which have hung about the third test have now been dissipated. Mr. C. E. St. John, of Mount Wilson, who had thrown the gravest doubts on the experimental facts, has now come round definitely in favor of the Einstein result. He makes his own announcement in SCIENCE for September 28. Mr. Evershed (who has just retired from a long and able directorship of the Kodaikanal Observatory in Southern India) had already given very strong evidence in favor of Einstein, but the conversion of Mr. St. John is of obvious importance, and the joint testimony of these former opponents leaves the matter now in no reasonable doubt.

It is satisfactory to review the part that English astronomers have played in the establishment of this development of Newton's great law of gravitation. The Astronomer Royal pointed out, even during the war, the great opportunity of 1919, and English observers hastened to utilize it with success. Professor Eddington was one of the observers, and has played a leading part in the exposition of the new theory. Mr. Evershed stood for some time almost alone as the champion of the third test. We need not underestimate the value of the confirmation by American observers in both cases; but it seems due to those mentioned to remember the courage which secured their priority.—*H. H. Turner, University Observatory, Oxford, in the London Times.*

SCIENTIFIC BOOKS

Fortschritte der Geologie und Paleontologie. Heft 2. *Die Familien der Reptilien.* By FRANZ BARON NOPSCA. 210 pages and VI plates. Gebrüder Borntrager, Berlin, 1923.

MOST of the leaders in vertebrate paleontology have given us their ideas of the proper classification of the reptilia, and this paper adds a valued name to the list. There is no one whose knowledge of the reptilia, living and extinct, is more comprehensive than Dr. Nopsca, and no one whose opinion is more significant. In his paper Dr. Nopsca has brought together twelve suggested classifications which have been offered since 1890 over the names of such men as Cope, Zittel, Fürbringer, Huene, Broom, Watson and others, and to this list he adds his own as the thirteenth. A glance through these classifications illustrates clearly the difficulties inherent in the task; they show many and radical differences of opinion, both in the composition of the various groups and the relative taxonomic rank assigned to each, such as Super-Orders, Orders and Sub-Orders. Certain groups have attained a relative stability as to their content, as the Cotylosauria, Ichthyopterygia, Testudinata, Sauropterygia, Lacertilia, Crocodilia, Dinosauria and Pterosauria, but the taxonomic position is still uncertain and for some, even the content is still in dispute—witness the growing conviction that the Dinosauria is a composite rather than a coherent group, and the recent suggestion that the Pterosauria be divided.

The cause of this difference of opinion is largely due to the fact that each author has considered a different character or group of characters as of capital importance. Happily, classification is based to-day entirely upon genetic relationships, but the material at the disposal of the paleontologist is still too limited to permit a selection of the characters which reveal most accurately this genetic relationship; the personal factor is still prominent in each suggested classification. The most crying need in systematic paleontology to-day is a determination of what structures are fundamental in the development of any phylum and the direction of their evolutionary changes, as opposed to the secondary adaptive changes. Only when these have been determined and generally accepted will we have a consistent and uniform classification; until then each author must produce a mosaic of relationships based upon his individual opinion of the relative importance of certain characters. In the opinion of the author of this review a correct and generally acceptable classification will not be attained until the emphasis is shifted from the *form* to the

function; when all the factors which have determined the bodily structure have been determined and evaluated.

It is interesting to note that Dr. Nopsca's avowed method of procedure is to work from the end result back to the beginning, rather than from the simple, comprehensive type towards the highly specialized. Neither method can be entirely successful until far more material is collected and studied, but it may be seriously questioned whether a start with the primitive forms does not make it far more possible to determine fundamental structures and changes than to start with the most aberrant forms where the lines of genetic relationship are obscured by secondary adaptations, possible parallelisms, convergences and polyphyletism.

Dr. Nopsca offers us a careful comparative analysis of the structure of 25 forms which he considers the most aberrant or specialized; from this study he suggests a classification which contains ten Super-Orders, one of which is new, the Dranitesauria; 21 Orders, of which two, the Rhizosauria and Chainosauria, are new; and a correspondingly large number of sub-Orders and Families. In this arrangement we have a clear illustration of the unfortunate lack of uniformity; other authors are best satisfied to express conceived relationships by groups of lesser rank. To the experienced worker such shifts in the rank of groups means little, but to the student, to whom an Order is a positive concept, the matter is most confusing.

As is natural, Dr. Nopsca's opinions lead to a new mosaic of relationships, and, in the opinion of some, to strange fellowships among the reptilia. We find the Thallatosauria grouped with the Pelycosauria, the Mesosauria with the Ichthyosauria and the Family Caseidae next to the Edaphosauridae.

As a part of his paper, Dr. Nopsca gives us a valuable review of the known reptilian footprints and more or less closely allocates each to distinct families or even genera. This discussion is most helpful and illuminating, but one hesitates to concede the accuracy of some of his suggestions, as when animals known only from distant regions are suggested as the makers of footprints found in England.

It is an interesting commentary on the breadth of the work in modern morphology that Dr. Nopsca speculates upon the effect of vitamines and hormones upon the development of Paleozoic and Mesozoic reptiles. This is but one of many evidences that the mere comparison of parts is no longer sufficient to him who would determine the genetic relationships which alone can form the basis of a true phylogeny. Physiology, environment, function—all these must be considered to have their share and must be read in the shape of the bones and in the sediments which reveal the environment during life of the animal remains there buried.

Dr. Nopsca's work is a most valuable contribution to the history of the reptilia, filled with information and abounding in suggestive interpretations.

E. C. CASE

UNIVERSITY OF MICHIGAN

SPECIAL ARTICLES

THE EFFECT OF FORMALDEHYDE UPON THE VITAMIN CONTENT OF MILK

THE desirability of a wholesome milk supply for every household is, of course, granted by every one. Common experience and scientific investigation have both shown the unquestioned value of milk in the diet, particularly for the child. The great problem to be solved, however, is that of bringing the milk from the producing dairy to the consumer within such time and under such conditions as to prevent harmful changes in the milk before its utilization. To meet the situation various methods have been proposed and carried out, the ideal one being the cleanliness and icing method that results in "certified" milk. Unfortunately, the necessary expense of such a method makes the product cost so much that it is only comparatively few who are able to use such a product for the family supply. The more common method is that of pasteurization, and its value as a method of insuring a useful milk for home consumption is not to be questioned.

However, investigators and dieticians are fairly well agreed that the process of pasteurizing is not without its drawbacks. It is conceded that the process results in the destruction of at least one vitamin to a very large extent, and most workers feel that the other vitamins also are depleted. This would, perhaps, not be a serious drawback if the milk were to be used by adults using an otherwise satisfactory mixed diet, but when the milk is to be used as the sole article of the baby's diet then the question does become an acute one. Usually, such a diet is supplemented by fruit juices or other similar sources of vitamins under such conditions. Nevertheless, thousands of babies, whose parents never heard of vitamins, are given the insufficient pasteurized milk with disastrous results.

Knowing the preservative value of formaldehyde, the following work was carried out within the past year to determine its possible usefulness in preventing undesirable changes in milk. T. M. Price,[2] working

[1] From the Department of Physiology, Ohio State University.

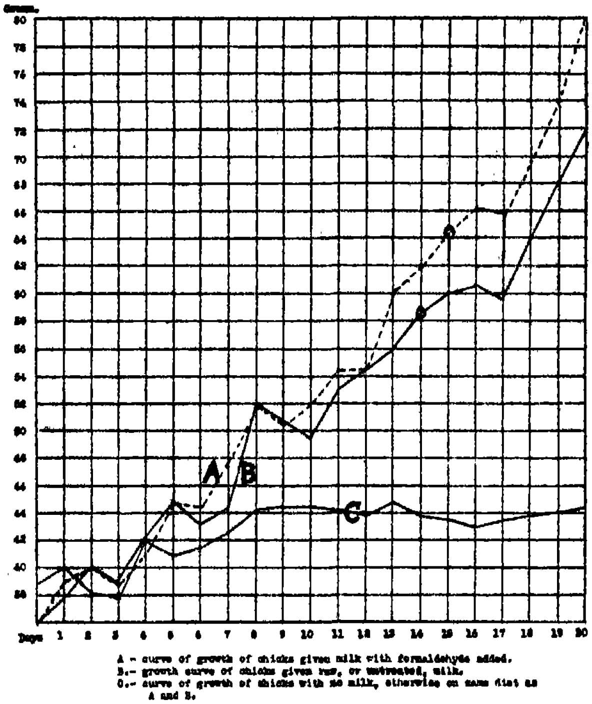
[2] T. M. Price, Centr. Bakt. Par., Abt. 2, 1905, 14, 65–75.

in the Biochemic Division of the U. S. Department of Agriculture, showed by a long series of experiments upon calves that formaldehyde, in proper amount to prevent souring of milk, had no ill effects whatever. Some of Price's conclusions were as follows:

"Formaldehyde in the proportion of 1:20,000 preserves the milk for 48 hours; used in twice that strength (or 1:10,000) it does not interfere with the digestion of milk when fed to calves." "Upon feeding calves through a long period with milk preserved with formaldehyde the calves remained healthy and gained in weight." "Much stronger solutions of formaldehyde (1:2,500) have no effect upon the activity of fresh enzymes—rennet, pepsin, pancreatin—in vitro."

The conclusions of Price are confirmed by the work done by Rideal and Fullerton,[3] although other workers have declared that formaldehyde does affect the coagulation of milk protein. However, those investigators finding such possibly harmful effects have universally used solutions of formaldehyde of much greater concentration than would be necessary to prevent milk souring—usually amounts varying from 1:25 to 1:2,000 being employed. At the time of Price's work vitamins were as yet unknown, and so it seemed possible that the effects of formaldehyde upon the vitamins of milk might be such as to preclude its usefulness as a preservative. An effort to determine the effects, if any, resulted in the following experiments.

Four years ago Seymour and Durrant[4] pointed out the utility of chicks as experimental animals in determinations of vitamin deficiency. During the past year Emmett and Peacock[5] confirmed these findings while using considerably larger numbers of chicks. Both sets of experiments showed that baby chicks are particularly susceptible to a lack of vitamins and thus lend themselves admirably to the determination of whether any particular diet is lacking in these essential substances. In the present experiments baby chicks were fed a diet practically free from vitamins (highly milled cornmeal baked into cakes, rice flour cakes, unleavened white flour cakes, etc.) with free access to grit, shell, charcoal, etc. Such a diet gives early evidences of lack of vitamins and results in a growth curve similar to "C" as shown upon the chart. Added to this diet in the present tests, however, was milk, both ordinary raw milk and milk treated with sufficient formaldehyde (1:20,000) to prevent sour-



A—Curve of growth of chicks given milk with formaldehyde added.
B—Growth curve of chicks given raw, or untreated, milk.
C—Curve of growth of chicks with no milk, otherwise on same diet as A and B.

ing at room temperature for at least 24 hours. The effect of the addition of the milk is readily seen by comparing growth curves "A" and "B" with the curve of growth when milk was lacking.

The chicks were divided into two groups of equal number and approximately equal weights. Each group had identical food, had access to the same brooder and were under the same conditions as to light, heat, etc. The sole source of liquid for the chicks was milk. Group B was given raw milk just as it came from the dairy, while Group A was given only milk that had formaldehyde added in the amount mentioned. The milk was "winter" milk, notably low in vitamin content, and hence, if the formaldehyde had any destructive action on the vitamins it should have been all the more readily noted, particularly when fed to the very susceptible chick. Two separate tests were run, one in March, 1922, and the second in November. The results of both were practically identical. The growth curves shown are those obtained in March, that of November differing only in that the chicks fed milk that had been treated with formaldehyde outstripped the other chicks to an even

[3] Rideal & Foulerton, Exp. Sta. Rec., 1900, 11, 582 (also, Rideal, Lancet, 1900, I, 228–230).

[4] Seymour & Durrant, *Ohio Jour. of Sci.*, 1919, XIX, No. 8, 509–512 (also, SCIENCE, N. S., XLIX, No. 1271, 448).

[5] Emmett & Peacock, *Jour. Biol. Chem.*, 50, Feb., 1922 (Proc. Amer. Soc. Biol. Chem.).

greater degree than is shown by the March curve presented.

Shown by a small circle upon the growth curves is the first appearance of any "vitamin-lack" symptoms. In each case the symptoms appeared first in the chicks given untreated milk, but not at a period enough earlier to have any especial significance. The results did show however that "winter" milk, at least, does not possess sufficient vitamins to prevent the appearance of symptoms of vitamin lack in the chick. Nevertheless, it is equally shown that the use of formaldehyde had no deleterious effect upon the growth processes. The results of a future test in which it is planned to compare the results obtained with pasteurized milk with those from the use of milk treated with formaldehyde should prove of interest.

If it can be shown that the use of formaldehyde in proper amounts does not have a harmful effect upon milk, it would seem that the question of preserving the milk from the dairy to the home would be much simplified, with the possibility that such treatment would be less harmful than the process of pasteurization.

A. M. Bleile
R. J. Seymour

Ohio State University

AMERICAN MATHEMATICAL SOCIETY

The two hundred and thirty-first regular meeting of the American Mathematical Society was held at Columbia University, New York City, on Saturday, October 27, 1923, extending through the usual morning and afternoon sessions. At the beginning of the afternoon session a paper was read, at the request of the Program Committee, by Professor Anna J. Pell, of Bryn Mawr College, on bilinear and quadratic forms in infinitely many variables.

The attendance included 68 members of the society. The secretary announced the election of 49 persons to membership in the society; 14 applications for membership were received.

The meeting was signalized by the passing from the unincorporated body known as the American Mathematical Society to a corporation of the same name, organized under the code of the District of Columbia. A revised set of by-laws was adopted, and the various legal formalities necessary to the transfer of the property were attended to. The following 31 persons constitute the Board of Trustees: J. W. Alexander, R. C. Archibald, B. A. Bernstein, G. D. Birkhoff, E. W. Brown, F. N. Cole, L. P. Eisenhart, H. B. Fine, W. B. Fite, T. C. Fry, H. E. Hawkes, Robert Henderson, H. L. Hodgkins, E. V. Huntington, S. A. Joffe, O. D. Kellogg, E. H. Moore, W. F. Osgood, A. J. Pell, M. I. Pupin, R. G. D. Richardson, J. F. Ritt, L. P. Siceloff, C. E. Smith, D. E. Smith, W. M. Strong, H. W. Tyler, Oswald Veblen, H. S. White, J. K. Whittemore, J. W. Young.

Votes of thanks were tendered to the committee on incorporation, to the incorporators and to the lawyers who gave their services.

A committee on the first Josiah Willard Gibbs Lecture was appointed, consisting of Professors H. E. Hawkes (chairman), E. W. Brown, J. L. Coolidge and H. S. White.

The following appointments were announced: To represent the society at the inauguration of President Updegraff of Cornell College on October 19, 1923, Professor E. E. Moots; to represent the society at the inauguration of President Comstock of Radcliffe College on October 20, 1923, Professor E. V. Huntington; to represent the society at the inauguration of President Hadley of Washington University on November 10, 1923, Professor W. H. Roever.

It was voted to print both the *Bulletin* and *Transactions* of the society for the year 1924 in Hamburg.

The following papers were read at this meeting:

Spaces of continuous matter in general relativity: L. P. Eisenhart.

The deformation of ruled surfaces: J. K. Whittemore.

Analytic vector functions: G. Y. Rainich.

Systems of ∞^{2n-2} curves in a Riemann space in which the sum of the angles of every triangle formed by three of the curves is two right angles: J. Douglas.

Necessary and sufficient conditions that a system of ∞^4 curves in space consist of the mutual intersections of ∞^2 surfaces: J. Douglas.

On Ricci's coefficients of rotation: J. Lipka.

Types of alignment charts in three variables: J. Lipka.

On the mean-value theorem corresponding to a given linear homogeneous differential equation: G. Pólya.

Note on stability à la Poisson: F. H. Murray.

On infinitely connected plane regions: J. W. Alexander.

On the deformation on an n-cell: J. W. Alexander.

On the reality of the zeros of a λ-determinant: R. G. D. Richardson.

Sets of completely independent postulates for cyclic order: E. V. Huntington.

Some corollaries of Bernstein's theorem: D. Jackson.

Theory of generalized differentiation: E. L. Post.

The society will hold two meetings in the last week in December: the annual meeting, in New York City on December 27–28, and its twentieth western meeting, in Cincinnati, in conjunction with the American Association for the Advancement of Science on December 28–29.

R. G. D. Richardson,
Secretary.

SCIENCE NEWS

TESTS OF LOCOMOTIVES

Science Service

RAILROAD officials, representing a majority of the leading railroads of the country who went to Erie, Pa., to witness a demonstration of new types of electric locomotives and were thrilled to see one of the powerful Mikado type steam locomotives pulled backwards in a spectacular tug-of-war by an electric giant, and to see another type of electric locomotive glide over the rails at 105 miles an hour, found great interest in another device known as the otheograph, which accurately measures the stress or action on the rails of each separate wheel of a locomotive or motor car.

This new instrument, as explained by A. F. Batchelder, designing railway engineer of the General Electric Company, shows by a graphic chart the extent and characteristic of both the vertical and sideways thrust of all the wheels on each rail. The vertical weight is carried by heavy springs underneath the rail and the sideways thrust is carried through similar springs set vertically and bearing against the head of the rail. The deflection of these springs on the passage of the locomotive is recorded through a lever having an 8 to 1 ratio, with a pointer at the end which traces a record on paper wrapped around a rotating cylinder.

The otheograph ties may be installed in place of the regular ties, either singly or several grouped together, and on curves or straight tracks. The present installation at Erie comprises 25 of these ties grouped together covering a distance of fifty feet of straight track. The revolving mechanism provides for moving all of the recording cylinders on each side of the track simultaneously so that as many records may be taken of each side of the locomotive as the number of ties that are grouped together. The movement of the operating mechanism for the recording cylinders is independent of the speed of the locomotive.

The record from a slowly moving locomotive shows the equalized distribution of the weight, and such a record serves as the basis for comparison with a record taken at high speed. The effect of side thrust in changing the vertical component, and any variations due to dynamic unbalance, are quite noticeable. The effect of a wheel with a flat spot shows very clearly. The record is not necessarily limited to that of a locomotive only, as by moving the paper slowly the record of all wheels of an entire train of a hundred or more cars may be taken.

NAUTICAL TIME

Science Service

BY agreement of the United States, England and France, the U. S. Nautical Almanac and the corresponding publications in the other countries are going to suffer a revolutionary change in the interest of safety at sea, beginning with the issue for 1925, now about to be issued.

The change is in the method of expressing time. It is now given in astronomical time, the day beginning and ending at noon. In the almanac of 1925 it will be given in civil time, the day beginning and ending at midnight. In each case the time is that of Greenwich Observatory, the time standard for all astronomical observations. Hours will be counted from 0 to 24 as in the present almanac.

The change will do away with an endless amount of confusion and danger, navigators say. The astronomical day begins 12 hours later than the civil day of the same date; that is, January 1, astronomical time, begins at noon of January 1, civil time. This difference frequently causes confusion, navigators neglecting to note the change or figuring it as just the opposite. Errors from this cause might amount to as much as 10 or 20 miles in working out the position of a vessel at sea. This danger will be ended by the new system, which has been recommended by navigators for years and which will finally be put into effect.

Incidentally, the change will require a new edition of that handbook of every navigator, Bowditch's American Practical Navigator. All the problems in the book are worked out according to the old system, and there is a lengthy section instructing the novice how to convert civil into astronomical time. This will all have to be changed, the burden of the work falling on the U. S. Hydrographic Office.

FORECASTING AT SEA

Science Service

FRANCE is leading the United States and the world in weather forecasting on the sea. According to the annual report of the chief of the U. S. Weather Bureau, French meteorologists and forecasters have been making regular trips across the Atlantic on their naval training vessel Jacques Cartier, have been collecting weather reports by radio from all parts of the North Atlantic and have been using them as the basis for forecasts sent out daily for the benefit of mariners.

But this vessel makes only about three voyages a year, and so the U. S. Weather Bureau has prepared plans for a service similar but continuous which may be given from vessels operated by the U. S. Shipping Board. That organization has approved the plans and has offered cooperation in the way of providing facilities on Shipping Board vessels on the northern transatlantic routes. Three vessels would be needed for continuous service. The need for such a service was demonstrated last winter, since storms on the Atlantic were unusually frequent. Its value would be, "to keep vessel masters informed at all times as to weather conditions which might cause damage or retard progress; enable them to avoid such storms as far as possible; to lay out ship work *en voyage* and

SCIENCE

VOL. LVIII DECEMBER 28, 1923 No. 1513

CONTENTS

SCIENCE: A Weekly Journal devoted to the Advancement of Science, edited by J. McKeen Cattell and published every Friday by

THE SCIENCE PRESS

Lancaster, Pa. Garrison, N. Y.

New York City: Grand Central Terminal.

Annual Subscription, $6.00. Single Copies, 15 Cts.

SCIENCE is the official organ of the American Association for the Advancement of Science. Information regarding membership in the association may be secured from the office of the permanent secretary, in the Smithsonian Institution Building, Washington, D. C.

Entered as second-class matter July 18, 1923, at the Post Office at Lancaster, Pa., under the Act of March 3, 1879.

A RETROSPECT[1]

It is the custom of our association that the annual presidential address should be delivered, not by the actual president, who assumed the responsibilities and honors of his office at the close of the last meeting a year ago, but by his predecessor, who by courtesy is termed the "retiring president" although as a matter of fact he is not "retiring" but "retired." He has to the best of his ability sustained the responsibilities of the presidency and has been relieved of them, he has enjoyed the honor of the position and has retired beyond the range of the spot-light only to be dragged into it once more with even greater responsibilities than before. Professor Dana in his presidential address of nearly seventy years ago describes this situation more eloquently than I can. "In most offices," he said, "the duties terminate with the office, and the thing of the past, the ex-officer, is to the present an unknown quantity. But it is not so with your president. Science . . . sternly drags forward its reluctant presidents to their hardest trial when they have ceased to be, to a judgment after death severer than that of Rhadamanthus." And Professor Asa Gray nearly twenty years later naturally and happily employing a botanical metaphor, compared the president to a biennial plant: "He flourishes for the year in which he comes into existence and performs his appropriate functions as a presiding officer. When the second year comes round, he is expected to blossom out in an address and disappear."

This arrangement has its advantages in that it affords what should be ample time for the preparation of such an address as the occasion and the position demands; for a speaker from this rostrum is confronted with the responsibility of speaking as one having authority, as a representative of science and while he may not have the ability to duly mix "reason with pleasure and wisdom with wit," he may be expected to set forth with surety and clarity the faith that is in him as to the achievements and progress of science, or at least of that department of science which he cultivates. Few can see this responsibility approach with cool, calm composure and assurance and alas! the very fact that one has apparently ample time for the preparation of one's pronouncements

[1] Address of the president of the American Association for the Advancement of Science, Seventy-fifth Annual Meeting, Cincinnati, 1923.

with most of us merely leads to the postponement of that preparation until in the fulness of time it is forced upon one. I confess that this has been my own case and that I am one of those "who time gallops withal." I make this statement not in extenuation but in explanation.

But while I fully appreciate the burden of responsibility that rests upon my shoulders it is with a peculiar satisfaction that I appear here to-night. That I have recently held the highest office in the gift of this association is in itself a source of the greatest pride and satisfaction, but these feelings are enhanced by the fact that I am a witness for the broad spirit of catholicity shown by the association in that it declines to recognize geographical boundaries to scientific endeavor. My presence on this platform is the outcome of a recent meeting of the association on Canadian soil and is to be regarded as a compliment to the association's hosts on that occasion, the University of Toronto and the Royal Canadian Institute. We esteem it an honor that we should have been permitted to act as your hosts, we rejoice in such invasions across our boundary, invasions that tend to maintain and strengthen that *entente cordiale* which, with some slight and temporary perturbations, has characterized the relations of the two countries for well over a century. Let us hope that a century hence a future president from the neighboring Dominion may speak in similar words—omitting reference to perturbations, though that seems almost too much to hope for.

The meeting of 1921 was not the first but the third meeting of the association in a Canadian city, nor am I the first Canadian to be honored with its presidency. At the meeting in Montreal in 1882 the presiding officer was Principal J. W. Dawson, of McGill University, distinguished for his contributions to Canadian zoology and geology and one of those who, like Louis Agassiz, could cultivate with equal success two of the great fields of science that were then included under the term natural history. How these fields have been extended in the forty years that have elapsed and how zoologists and geologists, ever pushing onward the frontiers of their respective territories, have drifted apart, until now each has developed a peculiar dialect which the other finds difficulty in understanding! This is one of the penalties of increasing knowledge.

There is a third president of the association who may perhaps be claimed as a Canadian, I mean Professor T. Sterry Hunt, a distinguished chemist and mineralogist. He was born, it is true, south of the Canadian boundary and the closing years of his life were passed in his native land; but for quarter of a century he was an active and valued member of the Geological Survey of Canada, under Sir William Logan, the first director of that survey. Professor Hunt was the acting president of the association at the Troy meeting in 1870, at which time he was still a member of the Canadian Survey.

I call attention to these facts only to emphasize the broad spirit of fellowship that characterizes this association. Its object is the advancement of science, and it is ready to extend the privileges of its meetings and the stimulus that they bring, wherever, upon this continent, they may be welcome. Canadian scientists and Canadian science have always been as welcome at the association's meetings as that brand of scientist and that brand of science that is produced in the United States. Furthermore arrangements are now on foot whereby it is hoped that the influence of the association in promoting the advancement of science will be extended to the republic that lies south of the Rio Grande and the association is thus justifying its title of American in a fuller and broader sense than that usually attached to that designation. It is working toward the realization of the ideal expressed in its first by-law, which lays down the principle that "The association is American, its field covering North, Central and South America. Inhabitants of any country are eligible to membership." It strives for the advancement of science, wherever cultivated, as a potent factor in civilization.

This broadening out policy is one that has been inherited by the association from its immediate ancestor, The American Association of Geologists and Naturalists. This association, which was primarily one of geologists, was organized in 1840 as the result of the inauguration of geological surveys of various states of the Union. Those engaged in these surveys felt the necessity for cooperation and discussion that there might be uniformity in the presentation of the results of their work. Soon the zoologists and botanists—the naturalists—were drawn in. Some chemists from the first had been included in the association but, in time, their department became a large and important one and finally the meteorologists found a congenial atmosphere in the association. So the scope of the interests of the association broadened out and at its 1847 meeting, held in Boston, it was decided that it should assume a title more indicative of its scope, and at the meeting of 1848, held in Philadelphia, it became the American Association for the Advancement of Science and in keeping with the new title it extended its membership to include general physicists, mathematicians, economists and engineers.

Thus our association had its beginning more than seventy-five years ago and at the close of its inaugural meeting it had a membership list of 461, an excellent showing, especially when it is recalled that in the early years there were certain restrictions of the membership that were subsequently made less definite. From the beginning, however, it has had the support

of the leading scientists of the country; on its first council were Professor Jeffries Wyman, Professor Benjamin Peirce, Professor S. S. Haldeman, Professor Joseph Henry and Professor Louis Agassiz, names that we of to-day recall with reverence and admiration, names that will forever stand in shining letters on the records of scientific achievement in this continent. With such men in control of its affairs success was guaranteed to the young association; it at once became the rallying ground for scientists in all departments of research and in turn attracted those who were interested in scientific progress without taking active share therein. For, as Professor Bache remarked at a later meeting, "Who will say that they do not return wiser, better, more zealous according to knowledge from a meeting—with Henry, Peirce or Agassiz?"

This first meeting is of interest too from the standard of papers presented. Foremost among these was an exhibition by Lieutenant Maury of charts of the North Atlantic showing the prevailing winds and currents, deduced from the study of many thousand old log-books, an earnest of what was to develop later into the classical "Physical Geography of the Sea." Lieutenant Maury demonstrated clearly the relation of intensive scientific investigation to practical results, for his charts indicated that the route usually followed by southbound vessels did not allow them to profit by the most favorable winds and by selecting another route, deduced from his observations, and testing it by a number of vessels, it was found that the passage could be made in three quarters the average time taken by vessels following the older recognized route. The introduction of steam navigation in the years that followed detracted greatly from the direct utilitarian importance of Lieutenant Maury's investigations, but he had laid the foundations for our modern science of oceanography and had established principles that, for a time at least, greatly favored commercial intercourse with distant portions of the globe, especially that between this country and the east and that between Great Britain and her Australian colonies. The voyage from Liverpool to Australia in earlier days usually occupied some four months or more, but in 1854 a sailing vessel, following the course advocated by Maury, made the passage in sixty-three days, and that course even in these days of steam, is still largely followed.

Another important paper presented at the first meeting was that on "The Sediment of the Mississippi River" by Dr. M. W. Dickeson and Mr. Andrew Brown, a summary of deductions based on observations extending over eighteen years, and mention should also be made of a series of papers by Agassiz, fresh from his expedition to Lake Superior, on whose shores his practised eye found abundant evidence of glaciation and whose waters yielded to him a rich harvest of fishes which he could compare with the fresh-water fishes of Europe and those of the Spix collection from Brazil that he had already studied.

One may not linger over this first meeting, nor may one pause to note the many interesting contributions presented at later meetings. The activity of the association in these early days was sufficiently great to warrant the holding of two meetings in each of the years 1850 and 1851 and the first of those of 1851, the fifth of the association, was held in this city in the month of May, under the presidency of Professor Alexander Dallas Bache, the distinguished and efficient director of the Coast and Geodetic Survey. The college professor of the fifties was not the migratory bird he has since become, nor were there then the inducements to extensive peregrinations that now exist. The colleges and scientific institutions were ranged along the Atlantic sea-board, the great State Universities, now such important factors in our scientific progress, had not yet arisen, although the University of Michigan had opened her doors in 1841 with a staff of two professors and with eleven students in attendance. All previous meetings of the association and those of the parent society had been held in cities of the Atlantic coast; the May meeting of 1851 was the first held beyond the Alleghanies and in 1851 a journey beyond the Alleghanies was not one to be lightly undertaken, it was an adventure. It may interest you to-night to hear of the expectations of Professor Henry and of the realities he found in attending the first meeting of the association in this city. He confessed that it was the first time that he had been west of the mountains and went on to say that "He expected to see a boundless, magnificent forest world, with scattered dwellings and log-cabin villages and energetic New England-descended inhabitants; he thought to find Cincinnati a thriving frontier town, exhibiting views of neat frame houses with white fronts, 'green doors and brass knockers,' but instead he found himself in a city of palaces, reared as if by magic and rivaling in appearance any city in the eastern states or of Europe." Professor Henry's expectations might have been realized some fifty years earlier; in the meantime Cincinnati had grown to the stature of the Queen city of the West and with her material progress had not failed to make provision for the cultivation of the arts and sciences in such organizations as the Mechanics Institute, the Academy of Natural Sciences, the Mercantile Library Association and the Young Men's Lyceum of Natural History, all of which Professor Henry mentioned with the remark, "These are the pride of Cincinnati—these her noblest works."

The first Cincinnati meeting was in itself a notable event as the first invasion by the association of what

was then still regarded as the West. But it was made still more notable by two other happenings. At the *preceding meeting* at New Haven, Professor O. M. Mitchell, to whose enthusiasm the erection of the original Cincinnati Observatory was due, and who was its director until 1859, reported that he had invented and constructed two instruments by which in a single night as many accurate determinations of right ascensions or declinations might be made as were made at the Royal Observatory at Greenwich in a whole year. This was rather a startling claim to be made by one working apart and with few of the resources available at the more richly endowed observatories of the East and of Europe, and a committee was appointed with Professor Peirce as its chairman to investigate the claim and report upon it at the Cincinnati meeting. The committee found that as to the apparatus for observing right ascensions the claim was fully justified and while a sufficient number of observations had not been made with the apparatus for determining declinations to warrant a definite statement regarding it, yet it was regarded as being perfectly correct in the principles of its construction. "The committee," I quote from its report, "are not aware that the history of Astronomical Science exhibits a more astounding instance of great results produced by what would seem to be wholly inadequate means. With the ordinary tools of a common mechanic and with insignificant pecuniary outlay an isolated individual has aspired to rival the highest efforts of the most richly endowed institutions—and his aspirations have been crowned with success." The fame of the Cincinnati Observatory was at once established, for the genius of its director had developed methods of observation that were later adopted by all the leading observatories of the world.

That was the *great* happening at the first Cincinnati meeting. The other one I would mention is of less moment in that it concerns only ourselves; it was the appearance upon the scene for the first time of that supremely important official, known as the permanent secretary. Presidents may and do come and go, each "struts and frets his hour upon the stage, and then he disappears." Not so the permanent secretary, he goes on forever. He came into being at the first Cincinnati meeting in the person of Professor Spencer Baird, and he has continued in existence ever since, in various incarnations it is true, assuming for a time the lineaments of Professor Lovering, then those of Professor F. W. Putnam, then those of Professor L. O. Howard and finally those of the present efficient holder of the office. With each incarnation the responsibilities of the office increased and I need not say, that in each these responsibilities were fully and satisfactorily met.

Thirty years were to elapse before the association again met in Cincinnati, that is to say, it was not until 1881 that a second meeting was held in this city, this time under the presidency of Professor G. J. Brush, of Yale University. We have seen that the first meeting was made memorable by an important change in the administration of the association; the second meeting was made memorable by the adoption of a new constitution involving some important changes in organization. Up to 1875 two sections had been tacitly if not actually recognized in the association, Section A including mathematics, physics and chemistry, and Section B including natural history. In the year mentioned the disruptive tendencies of specialization began to manifest themselves and the chemists segregated in what was officially termed a permanent subsection, a similar action was taken by the anthropologists, one year later the microscopists decided that their highly magnified world required a subsection for itself and five years later still the entomologists *deemed it necessary that they should betake themselves* to a special hive. For each of these four permanent subsections there was a chairman, while the presiding officers of the two original sections were designated by the more dignified term of vice-presidents.

By the new constitution adopted at the second Cincinnati meeting the permanent subsections were abolished and at the same time the association was divided into nine sections, each of which was presided over by a vice-president, who was required each year to give an address before his section. The nine sections were those of A, Mathematics and Astronomy; B, Physics; C, Chemistry; D, Mechanical Science; E, Geology and Geography; F, Biology; G, Histology and Microscopy; H, Anthropology, and I, Economic Science and Statistics. Mark the significance of this step. It was a recognition of the tendency toward specialization that had become so marked a feature in the science of the day, and established a policy that has prevailed up to the present. That is why the second Cincinnati meeting was a notable one. We are now entering upon the third Cincinnati meeting—that it too may be a notable one is what may be expected from the past, but whether its notability will depend on new developments of policy or on its records of scientific achievement we must wait to see.

The policy of specialization thus inaugurated in 1881 was bound to lead to further developments. The first modification of it, however, was in a retrograde direction, consisting of the absorption of Section G, Histology and Microscopy, into Section F, Zoology, in 1885. Looking back from our present standpoint it is difficult to understand why this section G was ever established and its absorption was a step to the good. But it was not long until Section G was re-established by the division of the section of biology

into sections of zoology and botany (1892). Then followed in 1900 the establishment of Section K for physiology and experimental medicine and in 1906 Section L was created for education and at the same time the title of Section H was changed to anthropology and psychology. Section M for agriculture was established in 1912 and in 1921 astronomy was divorced from mathematics, psychology from anthropology and new sections for historical and philological sciences and for manufactures and commerce were created, bringing the total number of sections up to sixteen. There are still some letters of the alphabet available for future sections.

Nor was this recognition of specialization the only sign of segregation in the association. A geographical segregation was bound to come as the sphere of influence of the association grew. It has come; for in 1914 a Pacific Division was established and in 1920 a Southwestern Division, each with its own constitution and officers, each holding its own annual meeting and yet remaining bound to the parent association by the closest ties of membership and purpose. If the vision that our first by-law calls up is to be realized it is evident that other divisions must be recognized, indeed, as has already been indicated, the establishment of a Mexican Division has already come to be a matter for deliberation. And what a vision it is that our first by-law calls up—a federation of divisions extending from the shores of the Arctic Ocean to Cape Horn, marching under one banner and with one purpose, the advancement of science and civilization!

So with segregation integration was also taking place. But the principle of segregation that the association felt itself obliged to recognize was not adopted as extensively as some groups of scientists desired and a tendency developed for these groups of specialists to form their own societies independent of the association. It became evident that if such secessions went on the representative character of the association would be endangered. Specialization had come to stay; indeed, it was bound to increase with the growth of the very object to which the association was pledged, the advancement of science. There were advantages for these societies in holding their meetings in conjunction with the association and it was to the advantage of the association that they should do so. That the mutual advantages might be ensured to some extent the council of the association was empowered to enter into relations with certain of these societies, which became designated as affiliated societies and, in time, were granted the privilege of electing one or in some cases two representatives to the council of the association. The number of the affiliated societies has grown prodigiously in recent years and amounts to something over fifty, a fact that may be taken as evidence of the success of this line of policy. The strength of the association does not depend alone upon the size of its membership, but this may be taken as an index of the extent to which it is fulfilling its purposes. Beginning with 461, the membership remained in the neighborhood of 500 until 1870, when a marked growth took place, bringing it up to 2,000 in 1885. Then followed a period of rest lasting until 1900, after which a steady and phenomenal growth occurred until now our membership is approximately 12,000. Surely in such figures we may find reason for congratulation and evidence of the wisdom of the policy laid down by the Council and ably carried out by our late permanent secretary, Dr. L. O. Howard and his successor, Dr. Burton E. Livingston.

Specialization must necessarily accompany progress. When one embarks upon a career of investigation one chooses a stream whose prospect pleases and for a time one floats placidly upon its bosom, following up its course. But soon it is joined by a large tributary and one must decide whether one will follow the right or the left branch. The decision made, one continues one's course, passing tributary after tributary, all of which, like the stream that is being followed, lead into unknown lands and at each a fresh decision must be made. In time the current strengthens, the journey becomes more arduous, difficulties are encountered, but still one keeps on, reaching farther and farther into the unknown and farther and farther from fellow searchers who have chosen other branches. One can not join them if one would, for they are ever advancing, perhaps with even greater rapidity and so one must perforce devote himself to the territory before him, hearing only by chance and at intervals rumors of the discoveries that are being made in other areas. That, it seems to me, is the experience of the investigator expressed in metaphor. The farther he and his associates advance the more they become isolated. New ideas demand new terms in which they may be discussed and so the members of each group come in time to speak a peculiar language and their isolation thus becomes more pronounced, for there is a limit to the number of languages that each of us can understand, some of us, indeed, have but a moderate command of even our native tongue.

And if this be a true statement of conditions, if it be true that even those familiar with the scientific methods find difficulty in appreciating the work of those laboring in other fields, how much more difficult must it be for those who from choice or from lack of opportunity have not had the advantage of a scientific training and yet are deeply interested in the progress and achievements of science. These form a not inconsiderable and important portion of our mem-

bership; they come to our meetings to hear something of the latest achievements of science and they listen to addresses largely in an unknown tongue. They ask for bread and are given a stone and profit little from such a monolithic repast. Yet these are the persons that we should endeavor to interest if we are truly and fully pledged to promote the advancement of science. Esoteric science may lead from discovery to discovery but until the significance of its discoveries is made intelligible to what are termed the men in the street it fails to secure popular support. The unintelligible is mysterious and mystery awakens either ridicule or dread.

Much has been spoken and written concerning the need for a popularization of science and something has been done towards its accomplishment, notably the establishment of *Science Service* so ably edited by Dr. Slosson. But is not this very thing a prime duty of this association, devoted as it is to the advancement of science, and does the association live up to the full measure of its responsibilities in this matter? I believe I am right in stating that we have not been so successful in this respect as some of the sister associations in other lands. True, we make some endeavor in providing special evening lectures that are designedly popular and I venture to suppose that the presidential addresses are expected to partake largely of that character. Nor will I be revealing any secrets of policy when I say that the council has given the matter serious consideration, and one may hope that its conjoint wisdom and experience will devise additional means to meet the difficulty. In the meantime it may seem temerarious to suggest measures looking to the betterment of the situation, but a retiring president has privileges and I feel so strongly the necessity for retaining and increasing the interest of what may be termed the lay members of the association in the aims and results of scientific research that I will venture a suggestion. Lack of understanding leads to misunderstanding, and I would beg that those who contribute papers to the sections, and especially the vice-presidents of sections, should in their deliverances bear in mind our lay members and strive for simplicity and perspicuity. Most of us are educators and we have in the meetings of this association opportunities for educating found nowhere else. Let us remember this and take advantage of our opportunities.

These ideas were suggested by the perusal of a number of addresses given by early presidents of the association. There runs through several of them an almost apologetic note, as if it seemed necessary to defend researches into the mysterious phenomena of the universe, since conclusions based on these researches tended to unsettle men's minds by undermining old long-standing beliefs. This was three generations ago and the practical applications of science were neither so frequent nor so striking as they are to-day. The Morse telegraph had been used commercially four years before the first meeting of the association, but the other remarkable applications of electrical energy that have become so much a part of our every day life were as yet undeveloped. Anesthesia had been introduced into surgical practice, but antisepsis, that was to revolutionize surgery, was as yet unknown; indeed, the causation of sepsis, together with that of putrefaction and fermentation was awaiting an explanation by the genius of Pasteur and this explanation was to lead up not only to surgical antisepsis, but to the formulation of the germ theory of disease and the wonderful achievements of modern preventive medicine. How these and other achievements in other departments of science have revolutionized the world! They are tangible evidences of the benefits that science can confer upon mankind, they are recognized as such by the man in the street and he consequently has developed an interest in science and a toleration of its votaries that his forbears of three generations did not possess. Nay, not only does he tolerate science, he encourages it by providing funds for its prosecution, by richly endowing great research laboratories and by bequeathing princely prizes as rewards for important discoveries. The distrust of seventy years ago has given way to trust and the world accepts with tranquillity the shattering of many old beliefs, providing that the necessity for their destruction is vouched for by competent scientific opinion. The theory of relativity, whether or not its full significance is understood, is swallowed without a spasm, even though it may displace the theory of gravitation from what seemed to be its unassailable position; and that the atom, supposed to be the ultimate, indivisible abstraction of human thought, is in reality a more or less complex system of electrons revolving planet-like about a central nucleus, even this idea is accepted without a tremor.

This change of attitude is undoubtedly largely due to an increased appreciation of the value of science as shown by its practical applications. This may not have been the only factor, but it is a potent one. It is impossible to consider the multitudinous and marvelous facilities that have become parts of our daily life without realizing that they are but the practical applications of scientific principles to the control or utilization of natural forces and materials, without, in other words, perceiving that it is to scientific investigation that we are indebted for these advantages. The men who have made these practical applications become known and respected, their names become household words, they are the representatives and high-priests of science and their glory is reflected upon even the most abstruse fields of scientific inves-

tigation. The attitude assumed may be expressed thus: "See what great benefits science has conferred! It promises others and therefore it is to be encouraged."

For the present we must perhaps be satisfied with this. For several centuries science was under the ban, dogma was supreme and science, which necessarily found itself in contest with this, was impious and heretical. Truth was standardized and complete and to question that accepted truth was to undermine the foundations of belief. The human mind is conservative in its reactions; habits of thought are as difficult of modification as habits of action and the change from the dogmatic to the scientific habit has been slow; indeed, it is far from complete even now. The utilitarian appeal of science has done much to emancipate it from its thraldom to dogma, but it is not yet universally recognized that the utility of science depends absolutely upon its success in discovering truth. It is only by getting at the true facts and the true principles involved in any problem that the results of science become useful. The scientist is a searcher after truth and it is for that reason that he is able to confer benefits on humanity; it is for that reason that he deserves recognition. Surely he should feel no necessity for an apology for his existence.

But the ultimate truth is elusive. When science establishes a truth that may seem at first to be ultimate it but points the way to another truth lying beyond and it is to the credit of scientific men that they are ready to admit the lack of finality in what has been accomplished, once the vista of the new truth has opened out. This attitude is not easily understood by the layman unfamiliar with the scientific method, and he is apt to imagine that a confession of lack of finality means the condemnation of the older truth as false. This is a misconception that has frequently occurred and, unfortunately, it is a misconception that scientists themselves have aided in creating, by failing to appreciate the popular view-point. In the popular mind the doctrine of evolution is so completely involved in Darwin's exposition of it that it has come to be regarded as the product of his brain. Consequently any acknowledgment that some of Darwin's views may require modification is assumed to imply that the foundations of evolution are shaken. It seems trite to repeat once more the true relation of Darwin's theory to the doctrine of evolution, but there seems to be need for its repetition. Evolution as a theory long antedates Darwin's time; Laplace, to go on farther back, found it in the history of the heavenly bodies, Lyell demonstrated it in the history of the earth, and Goethe, Saint Hilaire and Lamarck saw it in the history of terrestrial organisms. What Darwin did was to give a plausible and convincing explanation of how organic evolution might have occurred, but whether that explanation is or is not the correct one matters not so far as the doctrine of evolution is concerned; that stands unshaken even though Darwin's explanation of how it was brought about be discarded. The evidence in its favor to-day is many times stronger than it was in Darwin's time and it seems incredible that man as a reasoning animal should presume to doubt its validity; such doubts can be based only on ignorance of the evidence or on unreasoning prejudice.

True, it was Darwin who focussed the attention of the world upon the doctrine, by propounding the theory of natural selection as the causal factor in the transmutation of species. The biological world of to-day does not ascribe to that factor the importance that Darwin gave it. Its action can not be denied; it is self-evident to any observer of nature's ways who finds

> that of fifty seeds
> She often brings but one to bear.

It plays an important rôle in the suppression of the unfit rather than in the survival of the fittest, but it can act only on variations sufficiently pronounced to determine life or death. It has been shown in several cases that what seem trivial variations may, under certain conditions, lead to fatal results, but even admitting these, it is difficult to believe that many of the minute differences that distinguish species have selective value. Natural selection acts effectively in the perpetuation of species, but it does not originate them and to that extent the modern biologist may depart from Darwin's standpoint. Darwin was looking for the origin of species, the modern biologist goes a step further and is looking for the origin of variations and the mechanism of heredity problems far beyond Darwin's times. But he stands on the foundation built by Darwin, sinec the whole structure of modern philosophy rests on that foundation.

It would be interesting to sketch the story of the reception of the origin of species as revealed by the records of the association. But the date of its publication was 1859 and before there could be any extended criticism of it the members of the association found themselves face to face with the struggle for the preservation of the Union. From 1861 to 1867 the association held no meetings and by that time the first interest in the "Origin" had somewhat waned. In 1867, however, Professor Newberry in his address, while protesting against the obloquy and scorn that had been heaped on Darwin in many quarters as "peculiarly unjust and in bad taste," states his belief that the theory can not be accepted since, in his opinion, a single case of altruism would overthrow it. He overlooked the fact that individual altruistic sacri-

fice may benefit the race and it is the race not the individual that nature would perpetuate.

So careful of the type she seems
So careless of the single life.

Professor Asa Gray in 1872 was the first to express definitely in a presidential address his belief in a process of transmutation in organic life and, as was usual with him, he expresses himself so felicitously that I venture to quote his words. "Organic nature—by which I mean the system and totality of living things and their adaptation to each other and to the world—with all its apparent and, indeed, real stability, should be likened, not to the ocean, which varies only by tidal oscillations from a fixed level to which it is always returning, but rather to a river, so vast that we can neither discern its shores nor reach its sources, and whose onward flow is not less actual because too slow to be observed by ephemeræ which hover over its surface or are borne upon its bosom."

It is interesting to note that before 1859 the question of the permanency of species was already exercising the minds of members of the association. This was a reflection of the discussions on the same question that had earlier agitated the scientific world in Europe. The immutability of species predicated by the definition of the term by Linnaeus was being questioned and the idea of transmutation, later to be known as the doctrine of evolution, was in the air. This, let me repeat, was long before Darwin began to reflect upon the question during the voyage of the "Beagle," long before Wallace in the Malay archipelago began to think along the same lines as Darwin. In 1849 and again in 1850 Professor Agassiz approached the question, indicating the ideas later fully elaborated in his *Essay on Classification* according to which there was a definite plan in organic creation in which each species had its place from which there could be no departure. This position traces back to the influence of Cuvier, which is also manifest in a paper presented by Professor J. D. Dana at the meeting of 1857, in which, confronted with the variability shown by natural species and yet possessed by the idea of their essential immutability, he is driven to a position that forcibly recalls the Platonic theory of ideas or the metaphysical subtleties of scholastic realism, holding that "Species are realities in the system of nature while manifest to us only in individuals." I mention these pronouncements merely to emphasize the fact that the idea of transformationism, that is to say, the idea of evolution, was in men's minds long before the publication of the *Origin of Species*. These pre-Darwinian utterances were, it is true, in opposition to the idea of evolution, but that they should have been made is an indication that that idea was exercising men's minds.

Since evolution has become a fundamental doctrine of modern scientific philosophy it would be of interest to discuss its influence on scientific investigation. The field, is, however, too extensive to permit of adequate treatment of it as a whole and I shall, accordingly, limit my remarks to that portion of it with which I am most familiar and even then but a mere sketch is possible, so numerous and so varied have been the lines of investigation that have opened up since 1859. Unfortunately, here again the records of the association give but little assistance, since, after Professor Agassiz ceased regular attendance on the meetings, zoology for many years was but casually represented and the actual trends of zoological investigation were not clearly revealed by the papers read. But many of the new developments in zoology, its evolution, that is to say, fall within the memory of many of us older men and ample material is available by which the more recent developments may be connected up with the older viewpoints.

In the period immediately preceding Darwin the school of transcendental morphology was at its height and attention was concentrated upon finding the archetype structure, a general plan of organization which could be traced, with adaptive modifications, through the whole scale of animal life. The teachings of this school, led by Saint Hilaire in France, by Oken in Germany and by Owen in England, had a profound influence on zoological thought, especially in two directions. In the first place it divorced morphology, the science of structure, from physiology, the science of function, establishing the former as a special science whose problems were the discovery of homologous parts throughout the range of animal life. Homology was a purely structural idea, function had no place in the determination of the equivalency of parts and so, for the comparative anatomist, function ceased to be of interest.

In the second place by the predication of a structural archetype the transcendentalists opened the way to the idea of the essential unity of animal forms. If there were a primitive archetypal structure by modifications of which the various forms of animal life had been produced, there followed an implication of a definite relationship between these various forms, and the way was smoothed for the reception of the doctrine of evolution.

It is remarkable, however, how small a part comparative anatomy took in the establishment of the doctrine, although it possessed data of great pertinency and in great abundance. Darwin did, of course, make some use of these data, but he was not a comparative anatomist but rather a systematist, and the greater mass of the accumulated anatomical matter was left unapplied. Nor was there that burst of further activity that might have been expected in

comparative anatomy after the acceptance of the evolution theory. That may partly be explained by the serious blow dealt the transcendental school by Huxley in 1857 when, with keen logic and trenchant facts, he demolished the vertebrate theory of the skull, a critical and essential part of the transcendental belief. True, comparative anatomy did not languish in the post-Darwinian days; it could not with two such protagonists as Huxley and Gegenbaur, and its efforts were directed toward the substantiation and strengthening of the theory. But a more attractive field was suggested for study and to the investigation of this zoologists flocked as prospectors to a newly discovered gold-field.

The doctrine of evolution predicated a genetic relationship of forms, that is to say, each group of forms, species, genera, families or types each had a pedigree, each had behind it a long series of ancestors by the modification of which it had been developed. As far back as 1828 von Baer in his studies on the development of the chick had been struck with the resemblance which that form in its early stages showed to the embryos of other vertebrate types and expressed this fact in the law that the general characters of the great group to which an embryo belongs appear in development earlier than the special characters. Even earlier (1821) J. F. Meckel had maintained that the development of the individual organism obeys the same laws as the development of the whole animal series; that is to say, the higher animal in its gradual development passes essentially through the permanent organic stages that lie below it. These ideas in the days of the transcendental school could have little effect, though of great interest, but with the acceptance of evolution they took on a new meaning. In 1864 Fritz Müller, who had been studying the development of Crustacea while in exile in Brazil, published his results in a volume termed *Fur Darwin*, and in this expressed the idea that new species might be formed either by deviating from the parental type whilst still on their way towards that type or by passing through the various stages shown by the parents and then progressing beyond them. In the latter case "the historical development of the species will be mirrored in its developmental history." Haeckel in his *Generelle Morphologie* (1866) accepted Müller's idea, terming it the Biogenetic law which was to the effect that each organism in its individual development recapitulates more or less perfectly its ancestral history. If this law be true what an opportunity was offered by embryology for tracing the pedigrees of all sorts of animals and so to embryology the zoologists turned almost *en masse* and the construction of pedigrees, phylogenetic trees they were called, became the fashion. The development of representatives of every group of animals was eagerly studied and many an ardent genealogist concentrated his efforts on the construction of a pedigree for the vertebrates, solving the problem to his own satisfaction time and time again—but it is still unsolved.

At first, with the pedigree idea so fully in mind, the most striking features of the development of the various forms were sufficient for record, but in time the embryological became more minute, the history of the development was carried farther and farther back until the study of cell lineage came into existence in which step by step, cell division by cell division, the development of various forms was traced from the ovum until the principal organ systems were differentiated. The problem of embryology had changed; it was no longer a question of tracing more or less probable pedigrees, it was the question of the differentiation of tissues and organs of the multicellular organism from the single-celled ovum. It was no longer a search for evidence confirmatory of evolution, it was the beginning of the intensive study of the phenomena that lay behind variation and inheritance.

But in the meantime other lines of study had opened up. In the seventies and eighties of the last century attention was being directed to the remarkable phenomena that were associated with the division of cells and it was found that the process of division was in the immense majority of instances initiated and controlled by the cell nucleus. This body was found to undergo a series of extraordinary changes whereby its constituents were elaborated into a definite number of rod-like bodies termed chromosomes, each of which divided, and half the number thus formed passed into one of the daughter cells and the other half into the other, the nuclei of these cells being reconstituted from the chromosomes so distributed. The germ-cells and especially the sperm-cells proved favorable objects for such studies and their study led naturally to a study of the phenomena associated with the fertilization of the ovum. It would take too much time to recount the many interesting facts that were revealed by such studies; it will suffice for our present purpose to say that they gave very definite assurance for the belief that the chromosomes were the bearers of inheritable qualities, that it was by them that the parental characteristics were handed on to the offspring.

In 1893 there appeared a work by August Weismann, of the University of Freiburg, in which were summed up and elaborated certain doctrines that he had published earlier and which had an important influence on zoological thought. He drew a clear-cut distinction between the tissues which composed the body of an organism, the somatic cells, and the germ cells which served for the perpetuation of the species, and pointed out that there had been from the first a continuity of the germ-plasm; it passed on from gen-

eration to generation and was potentially immortal, using that term in a relative sense, whereas the somatic plasm of each generation suffered death and showed no continuity, but was formed anew from the germ-plasm in each generation. These ideas once they were pointed out seemed quite acceptable, and indeed, one might almost say, self-evident, but Weismann added a further idea in maintaining that the germ-plasm, and specific changes acquired by the cally isolated and could be affected only in the most general way by the somatic tissues. Consequently variations could arise only by modifications of the germ-plasm, and specifications acquired by the somatic tissue during the life-time of an individual could not be reproduced in the succeeding generation. Change of structure of the germ plasm was the sole source of variations and these could be perpetuated only by the action of natural selection in some of its forms. At once zoologists were divided into two camps, the Neo-Darwinians, who accepted Weismann's teachings on these matters, and the Neo-Lamarckians, who persisted in believing, as Darwin himself did, that acquired characters could be transmitted. The controversy waged long and in some cases bitterly and, indeed, is with us still.

In all these various lines of investigation zoologists were concerned almost exclusively with the structural side of the problem, the divorce of morphology and physiology which traces back to the transcendental school of comparative anatomists was still in force. In their study of cell-lineage they had seen the differentiation of form and structure appearing in the embryonic cells, but all the refinements of microscopical technique failed to yield an explanation of how and why that differentiation took place. Other methods must be applied and so, following the leadership of Roux, the method employed long before by Trembley, Réaumur and Spallanzani, the experimental method, the method of the physiologists, was revived. The developing ova were subjected to various changes of the environment, they were placed under pressure, the constitution and density of the water in which they were reared was altered, they were subjected to the action of various narcotic and other poisons, they were operated upon in various ways both in the very early and in later stages and the resulting modifications in the differentiation were noted.

Into the details of the results one can not enter now, the important point is the revival of physiological methods for the investigation of morphological problems, the re-marriage of physiology and morphology after a prolonged divorce. The old quarrel between form and function has been stayed, neither the one nor the other is antecedent and determining, but both work together; form can not be understood without a consideration of the function nor function without a full appreciation of structure. The recognition of the interplay of the two is the essential characteristic of modern zoological investigation and more and more the problems first opened up by studies of structure are being attacked along functional, experimental or physiological lines. In its early days the new method was spoken of as if it had created a new science, that of physiological morphology, but it has since become so familiar that any special designation of it is deemed unnecessary.

Once revived the method of experimentation was so prolific of results, especially in embryology and in the study of the regeneration of lost parts, that it soon became applied to the most varied lines of zoological research. One can not consider all these even sketchily, but only some of the more important ones may be mentioned. Variation and inheritance were accepted by Darwin as axiomatic forces, they were taken for granted and the theory of natural selection was built upon them as upon foundation stones. The breeding and hybridization of domestic animals and cultivated plants had of course been carried on from time immemorial, but the fundamental laws governing inheritance had not been established. Varieties were obtained by crossing different strains, but it was a hit or miss process, and if desirable varieties did occur they were preserved by a process of artificial selection. It was not until 1889 that Francis Galton attempted the formulation of a law of inheritance and that on quite general lines, but it was sufficient to arouse interest in the matter; experimental breeding was begun and soon the interest grew with the discovery of accounts published in 1866 and 1867 in an obscure periodical, of the remarkable results that had been obtained by Gregor Mendel in the gardens of the Monastery of Brünn. A study of these accounts revealed beyond peradventure the fact that the results of hybridization far from being elusive and fortuitous are governed by definite laws which it was possible to deduce from Mendel's observations. The study of inheritance was thus placed upon a scientific basis and experimental hybridization was carried on extensively by Correns and others in Germany, by Bateson and Darbishire in Great Britain and by Davenport and Castle in this country. Mendel's law was confirmed and extended and, with the discovery of the fruit-fly, *Drosophila*, as a favorable form for experimentation, the brilliant researches of Morgan and his pupils established the location of the bearers of many inheritable characteristics in the chromosomes of the germ cells and even succeeded in indicating the position of these bearers in the individual chromosomes and their relative positions in these! As a result of all these investigations we now have an insight into the *modus operandi* of heredity undreamt of by Darwin and already we have reaped

practical benefits from them in the improvements of our strains of wheat, to mention but one example. What the science of eugenics, also based on these researches, may yet do for us is unknown—it holds out great promise.

Another line of research opened up by the experimental method was the study of the determining factors in animal behavior, a study of the responses of living matter to external stimuli such as light, temperature, contact, gravitation and other environmental forces, both physical and chemical. These were essentially studies in comparative psychology and therefore strictly speaking physiological, but, with the breaking down of the old distinction between form and function, it was perceived that they were studies of the adaptation of structure to function and they were undertaken mainly by men who had been trained primarily in morphological methods. They were studies in experimental morphology, studies of the response of the animal mechanism to external influences and they revealed the fact that while in the living substance there was a mechanism (the morphological side) by which responses could be manifested and sources of energy (the physiological side) by which the mechanism might be set in action, there was necessary also "a stimulus external to the responding protoplasm in order that an adaptive or orderly result should occur." (Davenport.) The stress placed by these studies upon a mechanistic explanation of animal activities promptly aroused the opposition of those who still clung to the earlier vitalistic explanation and, as in other cases where fundamental principles are involved, the contention still goes on and will continue until increasing knowledge reveals the truth.

More recently still another line of investigation has attracted those interested primarily in questions of form and structure and in this case also the morphologist has adopted methods and ideas from sister sciences. The physiologists had demonstrated the existence in the body of special organs which manufactured substances influencing in definite ways the chemical activities of the tissues; they had shown that these so-called endocrine organs or ductless glands such as the thyroid, the pituitary and the islands of the pancreas, produced substances necessary for the normal activities of the body and that a lack of these substances resulted in definite and serious disturbances of these activities. Further they had shown that various tissues of the body produced similar substances, hormones, precipitins, secretins and lysins, each with a definite influence upon the activities of some other organ or tissue. All this was purely physiological, but morphologists were not slow to perceive that these substances could be usefully employed in the study of structural changes, and have turned to the study of growth and form as modified by them, have investigated their effects upon the processes of transformation from the larval to the adult stages in *Amphibia*, have sought in their action an explanation of the remarkable modifications in many organs associated with the phenomena of reproduction in higher animals and, quite recently, they have been employed by Dr. Guyer in studies on heredity. This use of endocrine substances in morphological research is but begun, its results may be realized in the future.

I would like to have considered some special instances in which the application of the experimental method has thrown a flood of light upon structural problems, such, for instance, as the fertilization of the ovum, the problem of sex-differentiation, in which direct observation has also played an important part, and the recent attempts of Stockard, Guyer, Detlefsen and others to throw light by refined experimental methods on the old problem of the inheritance of acquired characters, but time is lacking for their proper discussion. With regard to the last example I might add that while these experiments have failed to render a decisive answer to the problem they hold out hope that similar lines of research may at least result in the discovery of a neutral ground on which the contending camps may come together.

So with new methods the fields of investigation have broadened out and knowledge has increased by leaps and bounds. And it is with especial satisfaction that we may note that in these progressive zoological studies the scientists of this continent have always been well in the van, if not in the fore-front of the advancing column. But all through the almost overwhelming flood of new knowledge there runs the guiding clue supplied by the doctrine of evolution. That has been the stimulus and dominating idea in all these studies; without it many, very many of them would never have been conceived and knowledge would have lost thereby. No! Evolution is not dead, nor can it be killed by legislative enactment.

Let me conclude this retrospect with a message for guidance in the future, taken from one who did not always find satisfaction in the advances and applications of science, and all the more impressive on that account. It is not the first instance in which a prophet from whom curses might be expected gave blessings, real or implied, instead. The words are those of Mr. Ruskin. "Go to Nature," he says, "in all singleness of heart and walk with her laboriously and trustingly, having no other thought but how best to penetrate her meaning; and remember her instructions—rejecting nothing, selecting nothing and scorning nothing; believing all things to be right and good and rejoicing always in the truth."

J. PLAYFAIR MCMURRICH

UNIVERSITY OF TORONTO

THE ANDES IN NORTHERN PERU

MR. N. E. PEARSON has recently returned from a trip across the Western Andes of northern Peru, where he went to collect fishes. He started in June, 1923, and went direct to Lima to secure government cooperation. After making arrangements to facilitate travel he returned to Pacasmayo, a port on the northern coast of Peru. He went by rail to Chilete and then took the regular pack train route to Cajamarca, Celendin and Balsas on the Maranon. He retraced his steps to Cajamarca, from where he descended the Crisnejas valley to Tingo de Pauca, a point on the Maranon about 25 miles above Balsas. He touched the Maranon at one other point, Guayabamba, from where he returned to Pacasmayo. On the Pacific side he collected fishes from the basin of the Rio Jequetepeque from sea level to about 4,000 feet.

The crest between the Atlantic and Pacific slopes lies at an elevation of about 12,000 feet and about 75 miles from the Pacific. A valley about three miles wide with about 9,000 feet elevation lies between the divide and the next crest east, which is higher than the continental divide. The ancient Inca town, Cajamarca, lies in the valley. A small stream runs in the valley and descends to the Maranon. Going westward after crossing the second crest the road descends rapidly to Celendin at about the elevation of Cajamarca. Celendin lies in a valley without a living stream at the time of the visit. After crossing another crest east of Celendin, the road descends very rapidly to Balsas on the Maranon. There are but two breaks in the descent where there are small valleys perched on the otherwise steep slope. Collections were made in Cajamarca and at Balsas, about 3,000 feet. There were no fishes between these two places. The Maranon at Balsas is a swift stream running in a gorge and fishing was very difficult, which probably accounts for the fact that there are no native fishermen. Fishing was more successful in the Maranon at the mouth of the Crisnejas and along that stream. This portion of the Maranon seems to be above the point reached by the large lowland fishes. Only mountain climbers and Andean fishes were taken. The boundary to lowland fishes was elsewhere found to be about 3,000 feet. A few larger lowland fishes are found in the Urubamba valley up to the bridge below Machu Picchu and in the Perené, at least to La Merced at 2,500 feet.

Not all the catch has been unpacked as yet. Those of the Cajamarca valley provide one notable species. It is *Lebiasina bimaculata*, effectively used on the Pacific slopes of Peru and Ecuador as an eradicator of yellow fever mosquitoes. There is a small subfamily of Characid fishes distinguished by the presence of two series of teeth in the lower jaw. In one genus, Piabucina, the usual adipose fin of the Characidae is well developed and in Lebiasina not. Lebiasina has hitherto been taken only west of the Western Andes, *Lebiasina bimaculata* in western Ecuador and Peru, *Lebiasina multimaculata* in western Colombia in both the Atrato and the San Juan,[1] the former into the Atlantic, the latter into the Pacific.

The presence, therefore, of *Lebiasina bimaculata* on both sides of the Andes of Ecuador, but not at all in Colombia, is another indication that the faunas of Ecuador and Colombia are distinct and that either this species existed before the Andes of Peru attained their present height or that this species has crossed in one or both directions during the lifetime of the species.

Mr. Pearson's trip was made for the department of zoology of Indiana University. Part I of an account of the fishes of western South America[2] has recently been published. Part II, dealing with the fishes of Chile, is nearly ready for the press. Part III, dealing with the fishes of the Titicaca Basin, is in preparation, and the material for the fishes of the eastern slope of the Andes is collected in large part.

C. H. EIGENMANN

INDIANA UNIVERSITY

SCIENTIFIC EVENTS

NATIONAL PARKS

ESTABLISHMENT of additional national parks east of the Mississippi River is recommended in the Annual Report of the director of the National Park Service to the Secretary of the Interior, who writes as follows:

> There should be a typical section of the Appalachian Range established as a national park, with its native flora and fauna, conserved and made accessible for public travel and its development undertaken by federal funds, the report states. An untouched section of the Everglades of Florida also is suggested as being of national park importance. The Mammoth Cave area in Kentucky is regarded as a remote possibility for a national park.
>
> It is owned privately, administered under a will, the terms of which provide that upon the death of the last-named legatee it is to be sold at public auction to the

[1] The details of their distribution are given in Mem. Carnegie Museum, IX, 1922, pp. 123–125.

[2] The fresh-water fishes of Northwestern South America, including Colombia, Panama and the Pacific slopes of Ecuador and Peru. Mem. Carnegie Mus., Vol. IX, October, 1922 (issued January, 1923), pp. 1–346, plates I–XXXVIII, C. H. Eigenmann.

highest bidder. There are only two surviving legatees, both over ninety years of age, so it may be expected that this area known the world over will be disposed of before many more years pass by. Only a purchase, either by appropriation of Congress for the specific purpose, or privately, for donation to the United States, will enable the creation of this area as a national park. It is estimated that about $1,000,000 would be necessary for its acquisition. Bills have been introduced in Congress proposing its purchase at this figure, but as Congress apparently hesitates to establish a precedent by the appropriation of federal funds for the purchase of lands for national park purposes, it is doubtful whether it can be persuaded to favorably consider the acquisition of even the Mammoth Cave by this means. In my opinion, the only prospect is that when this estate is offered for sale at public auction some public-spirited organization or citizen may acquire it and donate it to the United States.

National parks, however, must continue to constitute areas containing scenery of supreme and distinctive quality, or some natural features so extraordinary or unique as to be of national interest and importance as distinguished from merely local interest. The National Park System as now constituted must not be lowered in standard, dignity and prestige by the inclusion of areas which express in less than the highest terms the particular class or kind of exhibit which they represent; distinguished examples of particular forms of world architecture, such, for instance, as the Grand Canyon of the Colorado, as exemplifying the highest accomplishment of steam erosion, or the Sequoia as presenting the highest form of accomplishment in natural tree growth, the wonderful *Sequoia gigantea*, or the Yellowstone as containing the greatest geyser basins of the world, or the rugged portions of the Lafayette National Park as exhibiting the oldest rock formation in America and the luxuriance of its deciduous forests.

NATIONAL RESEARCH FELLOWSHIPS IN PHYSICS, CHEMISTRY AND MATHEMATICS

The Rockefeller Foundation at a recent meeting (December 5) pledged to the National Research Council the sum of $625,000 for the maintenance by it, through the five-year period July 1, 1925–June 30, 1930, of a series of national research fellowships in physics, chemistry and mathematics. In addition the International Education Board has agreed to give special financial assistance in the case of fellows appointed to work abroad.

The council is already administering, with the financial support of the foundation, a first five-year series of such fellowships in physics and chemistry, the last appointments in which will expire June 30, 1925. The marked success of this series has led to the pledge by the foundation to support a second series in which fellowships in mathematics will be included as well as fellowships in physics and chemistry.

The National Research Council is also now administering, with the financial support of the Rockefeller Foundation, a similar series of research fellowships in the biological sciences and, with the support of the Rockefeller Foundation and General Education Board, a similar series in the medical sciences. Altogether the foundation and General Education Board have pledged or appropriated a total sum of $2,000,000 to the council for the maintenance of four five-year series of national research fellowships. The council is convinced that these high grade fellowships, available for young men and women of proved research capacity as evidenced not only by graduate work of sufficient extent and character to win the doctor's degree, but to reveal unusual ability in research work, can do much for the advancement of American scientific investigation.

Vernon Kellogg,
Permanent Secretary

National Research Council,
Washington, D. C.

DINNER IN HONOR OF DR. BOHR

On November 24, a group of Washington scientific men tendered a dinner to Dr. Niels Bohr, who has delivered a series of lectures on the atom in various cities of the United States.

According to the report in *Industrial and Engineering Chemistry*, Dr. Arthur L. Day, of the Geophysical Laboratory, acted as toastmaster, and F. C. Brown, of the Bureau of Standards, extended greetings to Dr. Bohr, who then spoke briefly on the great possibilities just ahead in the field of science due to recent discoveries, likening the present to the time of Newton which preceded great things in the scientific world.

Dr. Bohr was followed by P. D. Foote, who, to emphasize the size and great numbers of atoms, pointed out that if the molecules in a tumbler of water could all be labeled for later identification and the water were then mixed with all the water in the world, including the moisture in the atmosphere, and if after thorough mixing the tumbler were again filled, it would contain two thousand of the original molecules. Further, on the day of the dinner German paper marks were quoted at about sixty cents per trillion, and yet one paper mark would buy three billion gold atoms or sixteen thousand atoms of radium.

C. G. Abbot discussed the atomic theory as applied to the spectrum of the stars and F. G. Cottrell stressed the necessity of understanding the latest atomic and molecular theories in order to make real progress in the fixation of nitrogen, and said that the work of Dr. Bohr had set the pace. C. F. Marvin remarked that the study of the weather had not been reduced to such a fine point that atomic and molecu-

lar theories were thus far of direct applicability but it is recognized that the electrical condition of the atmosphere plays a great part and in studies of the future the theories now being developed in physics and chemistry will undoubtedly be extremely useful.

Preceding the dinner Dr. Bohr took part in a colloquium at the Bureau of Standards.

THE ENGINEERS' TESTIMONIAL DINNER TO DEAN COOLEY

Dean Mortimer E. Cooley, of the Colleges of Engineering and Architecture of the University of Michigan, was the recipient of a tribute such as come to few at the Engineers' dinner, which was given in his honor at the Hotel Statler in Detroit on November 23. It was a personal recognition, full of enthusiasm and honest sentiment, on the part of his friends, his former students and his confrères, everywhere. The speakers were:

Call to Order by Chairman, Alex Dow, M.Eng. (*Hon.*) '11, past president, Det. Eng. Soc.

Introduction of Toastmaster, Mr. Walter S. Russel, '75*e*, M.Eng. (*Hon.*) '10.

Mortimer Elwyn Cooley:

At his Boyhood Home, Robert F. Thompson, '92*l*, LL.M. '93, Judge 7th District, New York Supreme Court.

"As Cadet and Ensign," Ira N. Holis, President Worcester Polytechnic Inst., Mem. A. S. M. E.

"As professor of mechanical engineering," Ernest B. Perry, '89*e*, Mech.E. '96, Manager Industrial Works, Bay City, Michigan, Mem. A. S. M. E.

"In the service of his country," Hon. Edwin Denby, '96*l*, Secretary of the Navy, Represented by Admiral John K. Robinson, U. S. N.

"On the Yosemite," Granger Whitney, Williamsburg, Mich. Apple grower.

"As dean of engineering and architecture," Marion L. Burton, President.

"In the engineering profession," F. Paul Anderson, dean of engineering, University of Kentucky.

"In the Federated American Engineering Societies," Philip N. Moore, past president, A. I. M. & M. E., vice-president, Federated American Engineering Societies.

"As a companion," Hon. Chase S. Osborn, LL.D. (*Hon.*) '11, ex-governor of Michigan.

Dean Cooley did not speak but he held a reception after the dinner at which every one of the 550 engineers present extended their personal congratulations.

THE MEDALISTS OF THE ROYAL SOCIETY

At the anniversary meeting of the Royal Society held on November 30, the report of the council was presented and the president, Sir Charles Sherrington, delivered his address. Those to whom medals were presented and their qualifications were as follows:

Royal Medal. Professor Charles James Martin.—Professor Martin is distinguished for contributions both to physiology and to pathology. Investigating snake venoms, he differentiated two groups in virtue of their action, one nervous, the other, so to say, humoral. His work on heat-regulation in monotremes threw light on the evolution of the thermotaxis of warm-blooded animals. More recently his researches have lain in the colloidal chemistry of proteins, and in protein-metabolism. As director of the Lister Institute he has contributed to many investigations, in addition to those actually issued in his name. Thus he has been intimately associated with the inquiry into the influence of accessory food factors of diet in the prevention and remedying of "deficiency" diseases, such as scurvy and rickets, an inquiry the success of which may be regarded as one of the recent triumphs of preventive medicine.

Royal Medal. Sir William Napier Shaw.—In the great advances made during the last twenty-five years in the science of meteorology, Sir Napier Shaw has been amongst the foremost pioneers. During his twenty years' administration at the Meteorological Office, that office saw three marked steps forward: two of these were changes in its quarters; the third and greatest was the change in outlook of the work of the office, whereby it assumed, under Sir Napier Shaw's stimulating influence, the character of a scientific institution for the interpretation of meteorological phenomena. With the assistance of his scientific staff, he has developed the physical and dynamical aspects of the subject, and has done much to concentrate attention upon the thermodynamics of meteorology, wherein the motions of the water-laden air are interpreted as the action of a thermodynamic engine. His contributions to knowledge of the air and its ways have been largely responsible for changing the basis of meteorology from one of empiricism to one of science.

Copley Medal. Professor Horace Lamb.—For forty years Professor Lamb has been recognized as one of the most prominent and successful workers in applied mathematics in Great Britain. He is the foremost authority on hydrodynamics, not only in Great Britain but the world over. Professor Lamb's scientific activity, originally centering around the subject of hydrodynamics, has radiated thence into most branches of physical science and he may be regarded as the outstanding representative to-day of the school founded by Stokes, Kelvin, Clerk Maxwell and Rayleigh. In recent years he has made important contributions to seismology, the theory of tides, and other branches of geophysics. Specially perhaps should be mentioned the assistance he has given of recent years to the Aeronautical Research Committee. Mathematical questions involved in the flow of air round aircraft, in the action of propellers, and the stresses

in aeroplane structure, are of fundamental importance, but are exceedingly difficult; and here, as elsewhere, Professor Lamb's mathematical skill and power of clear exposition have proved of the highest value.

Davy Medal. Professor Herbert Brereton Baker.—Professor Baker's researches in various fields of chemical investigation, his examination of highly purified tellurium from various sources for the possible presence of higher members of the same group of elements, and the redetermination of its atomic weight, are of outstanding merit. It is, however, his remarkable researches on the influence of traces of water in modifying chemical change, whether of the nature of combination or of decomposition, which constitute perhaps his especial distinction. The results obtained by complete drying were as remarkable as they were unexpected, because they were in direct opposition to those which followed careful drying by usual methods. The bearing of Professor Baker's researches on theories of chemical change is as important as his conclusive experimental demonstrations of the phenomena themselves.

Hughes Medal. Dr. Robert Andrews Millikan.—Dr. Millikan has long been regarded as one of the most skilful experimenters in physical science. He is awarded the Hughes medal especially for his determinations of the electronic charge e and of Planck's constant h. When physicists were still ignorant of the value of the electronic charge to within 5 per cent., Dr. Millikan, by a method of the utmost ingenuity, arrived at the value $4.774 \times 10^{+10}$ E.S.U., for which he claimed an accuracy of one part in a thousand, a claim which has stood the test of time. His determination of h was not only remarkable in itself, but was of still greater value as finally vindicating the Einstein-Bohr view of the nature of the photo-electric phenomenon.

SCIENTIFIC NOTES AND NEWS

THE presidential address of Professor J. Playfair McMurrich, of the University of Toronto, given before the American Association for the Advancement of Science at Cincinnati on the evening of December 27, is printed in the present issue of SCIENCE. Subsequent numbers of the journal will contain the addresses of the vice-presidents of the association and others of the more important addresses and papers presented at the meeting. A special number will contain a full account of the proceedings.

JOHN TATLOCK has been elected president of the New York Academy of Sciences, in succession to Professor R. A. Harper. The vice-presidents for 1924 are: Carl P. Sherwin, Robert Cushman Murphy, William D. Matthew, Robert S. Woodworth.

AT the fifth annual meeting of the Chemical Industry Club of London, Sir William Pope was elected president and Professor W. R. E. Hodgkinson, vice-president.

JOSEPH BARCROFT, F.R.S., reader in physiology in the University of Cambridge, has been appointed Fullerian professor of physiology at the Royal Institution, London, in succession to Sir Arthur Keith.

DR. KONSTANTIN VON MONAKOW, professor of neurology in the University of Zürich and the author of numerous works on the normal and morbid anatomy of the brain and spinal cord, has recently celebrated his seventieth birthday.

THE degree of LL.D. is to be conferred on Dr. Simeon E. Josephi, Portland, by the University of Oregon at the commencement exercises at Eugene, in June, 1924, in recognition of his long services and to commemorate the twenty-five years he spent as dean of the medical school of that university.

DR. JACOB G. LIPMAN, of the University of New Jersey, has been appointed a member of the International Commission of Agricultural Ecology.

AT the meeting of the Washington Academy of Sciences on November 17, the following program was presented: "The Origin and Development of the Pan-Pacific Scientific Congress," by Dr. J. C. Merriam, president of the Carnegie Institution; "The Australian Meeting in 1923, the Scientific Proceedings," by Dr. T. Wayland Vaughan, of the U. S. Geological Survey; the resolutions adopted by the Congress on International Cooperation in Scientific Research, by Professor H. E. Gregory, of Yale University, director of the Bishop Museum, Honolulu.

THE following lectures have been given before the Astronomy and Physics Club of Pasadena:

November 2, "Anomalies of largely ionized substances in solution in the light of recent theories:" Dr. A. A. Noyes.

November 9, "An ether-drift experiment:" Professor E. B. Wheeler.

November 16 and 23, "The observational evidence of a velocity-restriction in space:" Dr. Gustaf Stromberg.

December 7, "Rainfall and sunspots:" Dr. Dinsmore Alter.

THE Physical Society of Pittsburgh was organized recently by 75 men interested in physics. The following officers have been elected for the coming year: Dr. L. O. Grondahl, *president*; Dr. G. E. Stebbins, *vice-president*; Dr. R. J. Piersol, *secretary-treasurer*. The society gave a dinner with Dr. Niels Bohr as guest of honor on November 28.

AMONG the lectures announced by the Carnegie In-

stitute of Technology for January are a series by Professor Harry N. Holmes, of Oberlin College, who will discuss "Colloid chemistry," "Emulsions," and "Gels" on January 9, 10 and 11; and a series by Professor Alfred Stansfield, of McGill University, between January 14 and 19 on "The electric furnace for iron and steel." Other public lecturers for whom definite dates have not yet been arranged are Dr. John R. Freeman, consulting engineer of Providence, R. I., and Dr. H. Foster Bain, director of the United States Bureau of Mines.

On December 8, Dr. W. M. Wheeler, of the Bussey Institution, Harvard University, delivered an address at Toronto before the Royal Canadian Institute on "Social Insects."

Dr. Henry Leffmann spoke before the Franklin Institute of Pennsylvania on December 13, on "Hydrogen-ion concentration in relation to animal and plant growth."

Dr. Alice Hamilton, of the Department of Industrial Diseases of the Harvard Medical School, lectured before the Boston University School of Medicine on October 19 on "What we know about industrial diseases."

Dr. Theobald Smith, of the Rockefeller Institute for Medical Research, gave an address on comparative pathology at the University of Edinburgh on November 27.

The Academy of Natural Sciences of Philadelphia announces the foundation, as a trust with the Academy, of "The Joseph Leidy Memorial Fund." The terms of the trust provide for the award of a memorial bronze medal every third year in recognition of "the best publication, exploration, discovery or research in the Natural Sciences in such particular branches thereof as may be designated." The foundation, which has been established by Dr. Joseph Leidy II, nephew of Dr. Joseph Leidy, also provides for an honorarium to accompany the award.

The Baillie Library of Chemistry, in connection with the department of chemistry of McGill University, was formally opened by a reception on Tuesday, December 11. Dr. Ruttan, the director, gave a short account of the development of the departmental library of chemistry and announced that the Baillie Library would be a continuation and development of the old departmental library, for which purpose an endowment of $25,000 had been made by the late Mr. John Baillie. The library, which already possesses thirty-nine sets of journals and periodicals, most of which are complete, was endowed in memory of George Irvine Baillie, a student in chemical engineering who was killed at the battle of Amiens in 1918. The reading room contains a portrait of Lieut. Baillie and a small, but unique, memorial window. The library will be developed as a reference library and new sets of reference journals in chemistry, as well as the missing volumes required to complete the present sets, are now being added as rapidly as possible.

The Medical School of Western Reserve University, in Cleveland, announces the availability of a "Crile Research Fellowship" at $1,500 per annum for graduates in medicine or others who have proper qualifications and desire to pursue research work in one of the departments of the Medical School. The candidate is eligible for reappointment at $2,000 the second year. Applicants may address inquiries or brief statements as to qualifications to the committee through Professor Carl J. Wiggers.

Neil M. Judd, curator of American archeology in the U. S. National Museum, returned to Washington recently after seven months' exploration in New Mexico and Utah for the National Geographic Society. During the months of May to September, inclusive, Mr. Judd directed the important excavations in Pueblo Bonito, largest of the great communal dwellings in Chaco Canyon, New Mexico. This season's activities concluded the third year of the Pueblo Bonito project; it is anticipated that at least two more years will be required for the complete exploration of this prehistoric village. Following his researches in New Mexico, Mr. Judd led a small reconnaissance party into San Juan county, Utah, to explore an unknown section lying north of the Rio San Juan and east of the Colorado. The prime purpose of the expedition was to ascertain whether further exploration in this region is desirable. Inasmuch as portions of the area visited had never before been entered by white men it is not improbable that the reconnaissance will be resumed on a larger scale at some future date.

UNIVERSITY AND EDUCATIONAL NOTES

Northwestern University has received a gift of three million dollars from Mrs. Montgomery Ward, to be expended in the construction of a medical center. It is to be known as the Montgomery Ward Memorial and will house the medical and dental schools and serve for medical welfare work.

Sir Heath Harrison, Bart., founder of the chair of organic chemistry in the University of Liverpool, has generously contributed a further sum of £2,500 towards the endowment of the chair.

Announcement has been made of the appointment of two vice-presidents of the University of Chicago. These are: Professor James H. Tufts, dean of faculties, and Trevor Arnett, formerly auditor of the uni-

versity and the past five years a secretary of the General Education Board. Professor Tufts will be charged with the responsibility of the development of the enlarging educational program of the university. Mr. Arnett will perform the function of business manager upon the retirement of the present business manager, Wallace Heckman, next June.

DR. RUDOLF BENNITT, of Harvard University, has been appointed assistant professor of zoology at De-Pauw University. He takes the place of Dr. Walter N. Hess, who has been granted a leave of absence to accept the Johnston Scholarship in the department of zoology at the Johns Hopkins University.

DR. C. E. WEATHERBURN, of Ormond College, Melbourne, has been appointed professor of mathematics at Canterbury University College, Christchurch, New Zealand.

DISCUSSION AND CORRESPONDENCE

ON THE MODEL OF THE HELIUM ATOM

IN a recent paper[1] Kramers shows that the energy of the crossed orbit model of the helium atom in its normal state when computed on the basis of classical dynamics comes out too low, 5.5235 W (W = energy of the hydrogen atom in its normal state), while the best experimental value is 5.807 W. He concludes that classical dynamics fails in atomic systems containing more than one electron, an idea also confirmed by a theoretical investigation of the excited states of helium by Born and Heisenberg.[2] As a suitable modification of classical dynamics the assumption appears reasonable that the moving electrons of such systems, instead of acting gradually and continuously upon each other in the classical manner, interchange energy and momentum in a sudden discrete way. The nature and magnitude of these exchanges shall be found by demanding a correspondence between the discontinuous and the classical processes.

This idea when applied to the crossed orbit configuration of the helium atom leads to a model of the same general character as the classical one. The electrons each have half a quantum of moment of momentum along the normal of the invariable plane, and their motion in the meridian plane is an oscillation under the influence of the nucleus alone, with abrupt changes of momentum at the end points, the magnitude of which shall be determined from the correspondence requirement. The ionization potential of such a model was found to be 5.799 W. The most important question is whether this reasoning can be generalized and applied to other systems.

RALPH DE LAER KRONIG

COLUMBIA UNIVERSITY

[1] *Zeit. für Physik*, 13 (1923), 312.

[2] *Zeit. für Physik*, 16 (1923), 229.

PLANT LICE AND LIGHT EXPOSURE

BECAUSE the true sexes in plant lice generally make their appearance in the temperate zone in the fall, the generally accepted explanation has been that the approach of cold weather or temperature is the causal factor. Along with the decrease in temperature in the fall, there is a much more marked relative shortening of the days; and it is this relative length of day to which the insects are exposed that appears to stimulate the production of the sexes; just as Garner and Allard[1] have succeeded in making ordinary fall flowering plants blossom in summer or at any other season by the employment of a short day.

In Tennessee the normal appearance of the oviparous females of *Aphis forbesi*, the strawberry root louse, is in the month of November; but by subjecting the insects, a few days after the eggs hatched February 23, to a short day of seven and one half to eight hours, out of doors in a ventilated dark chamber, the oviparous females appeared May 7 and eggs were deposited May 22.

The method used of subjecting the plants to a short day was to place the potted strawberry plants with the lice in the dark chamber at 5 o'clock in the afternoon. The following morning the plants were removed at 9:30 and placed in the light. Garner and Allard have shown that the difference in temperature inside and outside the dark house in their experiments was negligible, as the temperature inside was but 2° or 3° F. higher than the temperature outside; hence any responses on the part of the plants could not be attributed to lower temperatures.

Having been successful in the production of the sexes by the employment of a short day, and since the fall migrants or sexuparae of various plant lice are the antecedents of the oviparous forms, it was thought possible that the migration of plant lice is also due to the relative length of daily light exposure. And such was found to be the case with several species. Males and sexuparae of *Aphis rumicis* L., *Capitophorous hippophaes* Koch. and *Aphis Sorbi* Kalt. were produced experimentally in June when the temperature is high by keeping curled dock (*Rumex crispis*), smartweed (*Polygonum sp.*) and plantain (*Plantago lanceolata*), the respective summer hosts of the above species, exposed to a short day for about seven weeks. There was also obtained some evidence, which will be published shortly, that the production of spring migrants in such forms as *Aphis Sorbi*, the destructive rosy apple aphis, where they may occur in any subsequent generation after the 3rd, is governed by the increasing length of day of the spring months. The late appearance in *A. Sorbi* of the spring migrants which may result in a destructive outbreak,

[1] *Journal of Agricultural Research*, Volume 18: 553–606.

appears to be correlated with the length of day in relation to the time of hatching of the eggs.

S. MARCOVITCH
AGRICULTURAL EXPERIMENT STATION,
KNOXVILLE, TENN.

THE SANTA BARBARA SKULL

THE news items now being carried in SCIENCE Supplement are intended, of course, not for the specialist in the field to which they relate, but for those who may wish to keep in touch with the advance of science in general. This service is highly useful and is to be commended. However, by reason of the special object of the service, it becomes the more necessary that proper safeguards be thrown around these items to insure their essential accuracy. Signed articles written by specialists are judged on their merits. But with news items, it is expected that the information given either is uncontroverted or that the fact that it is controverted will be stated.

An item of news contained in SCIENCE Supplement of November 9, 1923, under the heading of "The Santa Barbara skull," departs so widely from the ideal standard of this service that it should not be allowed to pass unnoticed. The statements in question appear to have originated in the department of physical anthropology of the United States National Museum the name of Dr. Aleš Hrdlička of that department being mentioned. In this communication there is given as an item of news a categorical pronouncement as to the age of human remains found in America, and in addition an inaccurate statement as to one particular find of human remains. The antiquity of man in America is an extremely important matter to science, and at the present time is in controversy. Under these conditions it is not proper to circulate in *Science News Service* the opinion of one man, disregarding the opinion of all others who may be concerned with the same subject.

It is said in the news item under review that "the earliest human remains so far found in America date back only about three thousand years." Who, among those most experienced in reading time records, has examined the many finds of fossil man in America and determined this three thousand year limit? It is true that Hrdlička has reviewed the occurrence of early man in America. However, Hrdlička is a physical anthropologist and not a geologist, and the time element in this case is distinctly a geologic problem. Of course, those who choose to believe that man has been in America no more than three thousand years are privileged to do so. It is not, however, their privilege to circulate such opinions as unsigned items of news in a publication of the standing of *Science News Service*. Some others who have given attention to this subject have come to the conclusion that man has been on this continent for a very long period of time.

It is also said in the communication referred to that "in 1916, near Vero, Florida, remains were found which for a time were thought to be those of a very primitive type of human remains." This statement is incorrect; for while there was, and is, much difference of opinion as to the age of the Florida fossils, whether recent or Pleistocene, there has been no difference of opinion as to their character, no one having regarded them as primitive. The Vero human remains derive their particular interest from the fact that, although apparently structurally like modern man, they are there found in association with a considerable group of extinct species, including both plants and animals.

On the question of the method of interment of the Vero fossils, opinion is likewise divided. Hrdlička has been able to see in the remains only a human burial. On the other hand, others who examined the locality, including Berry, Chamberlin, Hay, MacCurdy and Sellards, found abundant and plain evidence in the geologic conditions to show that the human remains and artifacts were carried to their resting place by the stream and were a part of, and the same age as, the formation in which they were imbedded.[1]

In the case of the Vero find, Dr. Hrdlička, in advance of an examination of either the material or the locality, arrived at the conclusion that "both finds were seemingly burials."[2] Likewise in the case of the Santa Barbara skull an intimation of a conclusion in advance of the evidence is contained in the item published, in which it is stated that "anthropological experts of the Smithsonian Institution expect that scientific investigation by men trained in bone study will prove that the age of the supposedly primitive skull found at Santa Barbara, California, has been greatly overestimated."

The writer has no information on the Santa Barbara skull; it may prove to be recent. The present communication, therefore, is not a defense of that find, but is a protest against arriving at conclusions in advance of the evidence, and particularly against the use of *Science News Service* to spread propaganda favorable to certain particular views or theories.

E. H. SELLARDS
BUREAU OF ECONOMIC GEOLOGY,
UNIVERSITY OF TEXAS

[1] "Symposium on the age and relations of the fossil human remains found at Vero, Florida." *Journal of Geology*, Vol. XXV, Nos. 1 and 4, 1917. For a list of publications relating to the Vero fossils, see *Amer. Journ. Sci.*; (4), Vol. XLVII, pp. 358–360, 1919, or Fla. State Geol. Surv., 10th An. Rpt., 1919.

[2] Personal communication to the writer, July 20, 1916.

SCIENTIFIC BOOKS

Relativity and Modern Physics. By G. D. BIRKHOFF, Cambridge, Harvard University Press, 1923. xi + 283 pp.

WHEN one reads the opening sentence of the preface, "Although great interest has been aroused by Einstein's theory of relativity, there has not been available an approach to the subject which treats it adequately but with a minimum of technical requirements," he is apt to question the statement in view of the many books which had appeared before the statement was written, but then he concludes that the author is going to give us an account of how he thought himself into the theory. And he finds that the treatment is by no means a mere rearrangement of the material in other books. In many respects there is an originality in the point of view and treatment which makes it a book worthy of very careful study.

More than half of the book deals with special relativity, and in the greater part of this the phenomena of a space-time continuum of two dimensions are considered, although the generalizations to the space-time continuum of four dimensions are adequately presented. This specialization of the problem to two dimensions makes graphical representation easy, and consequently is very helpful. However, we question the advisability of carrying it to such an extent. For, after all, the student must, sooner or later, learn to think in four dimensions.

After a brief review of mathematical physics from the classical point of view, the next three chapters are devoted to a postulational treatment of space-time continua of two dimensions. After defining the apparent time t and apparent distance x of a particle B relative to a particle A by means of light-flashes from A to B and back in times t_1 and t_2, as measured at A, he introduces the graphs in terms of cartesian coordinates t_1 t_2 and x, t. Then comes the assumption (p. 24), "If in the space-time under consideration any naturally moving particle is assumed to be at rest and the velocity of light is taken to be constant (in particular, unity), then all other naturally moving particles will appear to move with constant velocities less than that of light." One asks "What is a naturally moving particle; is this its definition?" We should prefer a statement somewhat as follows: Any straight-line on the chart of an observer A making an angle θ with the t-axis would be interpreted by A as the world-line (previously defined) of a particle whose velocity relative to A is tan θ; we call it a naturally moving particle. The assumption tan θ < 1, which follows later from another assumption, is evidently introduced here to avoid imaginaries when the equations connecting the coordinates of two charts are obtained (p. 31).

In these equations there appears a function λ whose determination depends upon further assumptions concerning the nature of the space-time continuum, and chapters III and IV are given over largely to this question. Instead of starting with Einstein's fundamental postulate: "Natural phenomena run their course according to the same general laws with respect to coordinate systems moving relative to one another with constant velocity," which is essentially equivalent to Birkhoff's definition of an isotropic space-time (pp. 34, 49), the latter considers also what he calls "aeolotropic" space-time, from the definition of which it follows that space and time have an absolute significance. Both isotropic and aeolotropic space-times are isometric in the sense that "all portions of the space-time continuum are the same in so far as the metric relations which obtain in them are concerned" (p. 33). I believe that if the author had developed the isotropic case first and then considered the aeolotropic case, there would have been a gain in clarity. Moreover, repetitions could have been avoided, and the space thus saved devoted to added details which would help the reader. Particular attention should be called to the manner in which the expressions for the proper time are developed both in the two-dimensional and four-dimensional continua (pp. 31, 156); it emphasizes the fact that methods adopted in the former case can not be used necessarily in the latter.

After deriving in Chapter V the well-known formula for the composition of velocities in isotropic space and interpreting its significance, the author obtains by very careful physical analysis the equations of motion of a particle under the action of a force and points out the significance of the apparent mass, $m/\sqrt{1-v^2}$. Following the consideration of collision of particles, the dynamical equations of a system of particles are derived. These are used for the determination of the statistical mass of a system of particles in steady state. An interesting application is made in determining the expression for the pressure of light, when it is assumed that a beam of light is approximately a system of particles of slight mass moving with a velocity nearly unity. Another important application appears at the close of Chapter VII in the derivation of the differential equations of a perfect fluid in one-dimensional hydro-dynamics. The reader gets in this investigation and in the applications to a particle, measuring rod and clock, a valuable insight into the ideas and methods of special relativity. In the first part of this chapter the same equations are derived from a set of postulates. They serve to characterize the form of the equations, but I prefer the derivation previously referred to, as it

emphasizes the physical character of the problem. In Chapter IX the same topics for four-dimensional space-time are developed in essentially the same manner.

The development of tensor calculus is contained in Chapters VI and VIII. Although much of the treatment of the former deals with two dimensions and linear transformations, the formulas are general and the reader is so informed. Whether or not it was advisable to make these restrictions in presenting this subject depends upon the reader. After the introduction in Chapter VIII of the idea of geodesic coordnates at a point, that is, coordinates for which the first derivatives of the components g_{ij} of the metric tensor are zero at a point, there is a full and clear presentation of the particular type of geodesic coordinates introduced by Riemann in terms of which the equations of the geodesics through the particular point are linear. The author makes frequent use of these Riemannian coordinates throughout the remainder of the book. In this chapter he uses them to determine the Riemann curvature tensor, to define and explain covariant differentiation and to obtain the four fundamental identities connecting the first covariant derivative of the contracted tensor R_{ij} and the first derivative of the curvature invariant R. There is no denying the fact that the use of geodesic coordinates adds greatly to the simplification of processes involving covariant differentiation, but it would have been helpful had the general expression for covariant differentiation of a mixed tensor been written down. Also, it is to be regretted that the reader must look elsewhere for an interpretation of the geometrical significance of the Riemann tensor, either from the Riemann point of view, or in connection with the parallel displacement of a vector about a closed circuit. A further interesting and important application is made in Chapter XIII, namely, the determination of all space-time continua characterized by tensor equations which are linear and homogeneous in the differential coefficients of the second order and do not contain any higher derivatives. There are three essential types: (a) the Einstein spaces $R_{ij} = 0$; (b) the spaces for which $R = 0$ and $R_{ij} \pm 0$; (c) the spaces which can be mapped conformably upon euclidean space of four dimensions.

In the preface special attention is called to the postulational treatment of electromagnetism which appears in Chapter XII. The first postulate concerning the character of the force acting on a test charge yields a skew-symmetric tensor whose components are identified with the electric and magnetic intensities of the field. The second deals with the state of the field; the third requires the equations to hold for a state of equilibrium and the fourth that the derivatives of the intensities and the density of electricity enter linearly. The problem is to find the equations which satisfy these requirements and in addition are tensor equations with respect to the space-time continuum of special relativity. By very interesting mathematical analysis Maxwell's equations are derived. Here is a good evidence of what Einstein's requirement that the equations of physics be in tensor form means for the development of mathematical physics.

The reader is introduced to gravitation first in two dimensional space-time (Chapter IX). After a brief presentation of the Newtonian theory, Einstein's principle of equivalence is clearly defined (p. 141) and is used as the point of departure. On page 144 it is assumed "that the intrinsic equations $\int ds =$ an extremum, and $ds = 0$, respectively determine, as heretofore, the paths of naturally moving particles and light waves." To agree with the Einstein theory this must mean that a naturally moving particle is one in free space. It will be noticed that the author, like Einstein, does not assume that the paths of light are geodesics. However, in Chapter XVI, which deals with planetary motion, the deflection of light rays and the displacement of the spectral lines, as derived from the Schwarzschild form for ds^2, he takes the equation of a path of light as a limiting case of the motion of a particle. In obtaining the equations of hydrodynamics and electrodynamics for general relativity Einstein makes use of the explicit hypothesis, "With an appropriate choice of a local reference system special relativity holds for every infinitesimal four-dimensional domain or volume-element of the world." Birkhoff states its equivalent in terms of isotropic space-time (p. 145) and then proceeds to use it in connection with the equations

$$\frac{\delta T^{i\alpha}}{\delta x^{\alpha}} = 0,$$

where

$$T^{i\alpha} = \rho \frac{dx^i}{ds}\frac{dx^{\alpha}}{ds},$$

which are the equations of hydrodynamics in tensor form as shown in Chapter VII. He says that in general relativity these equations "must have the extended form

$$\frac{\delta T^{i\alpha}}{\delta \xi^{\alpha}} = 0\text{''},$$

where ξ^α are Riemannian coordinates. This is clearly an additional assumption; it means that the local coordinate system referred to is geodesic. Einstein[1] recognizes it as an assumption. In general coordinates it means that covariant derivatives are to replace ordinary derivatives. These remarks apply

[1] "The Meaning of Relativity," p. 91.

also to the generalization of the equations of electrodynamics of special relativity. Since gravitation is necessarily a four-dimensional space-time problem, this chapter merely serves to break the ground, but in Chapter XIV the reader finds the full treatment of the problem. The author's determination of tensor equations (previously mentioned) plays in well with his development of the subject, which is essentially a combination of Einstein's treatments of gravitation in his 1916 paper and in "The Meaning of Relativity," although the author makes no reference to the latter. Chapter XV is given over to a study of the solar field. In deriving the Schwarzschild form it is shown that the usual assumption that the field is independent of the time is unnecessary; this is an important result.

There are no footnotes, but at the end of the book there is a bibliography arranged according to the chapters in which the special subjects are treated. The book is well printed, and the only criticism as to form which I have to make deals with the page headings. It seems useless to put the title of the book at the head of alternative pages, when, had this space been used for section headings, it would have served a good purpose. Also an indication of chapter and section on each pair of pages would have made cross-reference easy.

L. P. EISENHART

PRINCETON UNIVERSITY

SPECIAL ARTICLES

SOME EFFECTS OF INSULIN AND GLUCOKININ ON MAIZE SEEDLINGS

IN experiments with a genetic type of maize, which is chlorotic and apparently unable to use its carbohydrates properly, tests were made to determine the action of insulin and glucokinin on the seedlings while still dependent upon the endosperm for food. The plants were started in sand, and when the first leaves began to unroll the seedlings were transferred to individual test tubes containing 20 cubic centimeters of distilled water and known quantities of either insulin or glucokinin. Each plant was supported at the top of the tube by absorbent cotton, and the roots were protected from the light. All of the fluid in the tube was poured off and fresh solution added every 48 hours, without removing the plant from the tube or disturbing its root system. Neither nutrient solution nor iron were given the plants during the experiment. The insulin and glucokinin were prepared by Collip's methods[1, 2] from fresh beef pancreas and onion tops, respectively.

[1] *Trans. Royal Soc.*, Canada, XVI, 1922.

[2] *Jour. Biol. Chem.*, LVII, 65–78, 1923.

As insulin and glucokinin produced in general the same response in seedlings, although different dilutions of the two substances were required, it is possible to group the results. In solutions carrying from 1 per cent. to 0.005 per cent. of glucokinin (or corresponding dilutions of insulin) growth was retarded, more or less, in direct proportion to the amount of glucokinin or insulin present. This retardation was particularly evident in the higher concentrations, and was more striking in root growth than in top growth. In the stronger solutions of both insulin and glucokinin the formation of secondary roots was practiaclly stopped. The growth of the primary roots and of such secondary roots as had appeared was behind that of the untreated controls growing in distilled water. The delayed growth of the tops was less evident during the first few days of insulin or glucokinin treatment, but became progressively more apparent as the experiment proceeded.

Seedlings grown in solutions of less than 0.005 per cent. glucokinin (or corresponding dilutions of insulin) showed some evidence of beneficial effects, as measured by the amount and character of root growth and the amount of top growth when compared with untreated controls. The retardation of growth by strong solutions and the beneficial effects of very dilute solutions were noted both in the series of chlorotic seedlings and in series of normal green seedlings treated with insulin or glucokinin.

A third reaction, an increase in the development of the chloroplastid pigments, was found in chlorotic plants growing in insulin and glucokinin solutions. Even when grown in strong solutions which were unfavorable to root development, chlorotic plants produced enough of the green pigments to appear distinctly green when compared with the untreated controls. A pair of chlorotic plants chosen at random, the one from an untreated series and the other from a series receiving so much insulin that the root growth was reduced to about one third normal, may serve as examples of the relative amounts of chloroplastid pigments developed. The untreated plant assayed less than 1 per cent. green pigments (chlorophylls), and the plant grown in insulin 28.7 per cent. in terms of the green pigments present in an untreated green seedling. The yellow pigments (xanthophyl and carotin) in the treated chlorotic seedling assayed almost 200 per cent. as compared with the untreated chlorotic seedling. Large numbers of seedlings of the strain of chlorotic maize used in these experiments have been grown under both field and greenhouse conditions, in connection with genetic studies, but no plant was ever found which had developed an appreciable green color.

In view of the fact that insulin and glucokinin may not be absorbed readily by the roots of plants

(Dudley[3] states that only a minute amount of the active principle of insulin passes through a collodin sac), the ends of the primary roots were cut off in one series of seedlings, so that the solutions might enter the plants directly through the vascular bundles. Seedlings treated in this fashion made better growth in the stronger solutions of insulin and glucokinin than the seedlings with uncut roots. In this connection the growth of green seedlings from which the endosperm had been removed was followed. Seedlings with the endosperm removed, when grown in distilled water under the same conditions as treated plants, showed retarded growth and produced root systems strikingly similar to those of seedlings with the endosperm intact but grown in strong insulin or glucokinin solutions. These tests collectively suggest a comparison with the effects of insulin on normal and diabetic animals. Banting and collaborators[4] have shown that it is possible to lower the blood sugar in normal animals by doses of insulin to a point where the animal dies in apparently the same condition as an animal dying from hypoglycemia following the removal of the liver. The beneficial effects of small quantities of insulin given to diabetic animals have been observed by many experimenters. It seems possible, therefore, that the retarded growth of the seedlings in strong solutions of insulin or glucokinin was produced by an action of these substances which rendered the carbohydrates of the endosperm unavailable. Since plants with cut roots made better growth in strong solutions than plants with uncut roots the experiments suggest that the retardation of growth is produced by a fraction which is easily absorbed through the uninjured root cells, and that the increased growth of plants with cut roots was dependent upon the presence of a fraction not readily absorbed by uninjured roots.

M. M. Ellis,
W. H. Eyster
University of Missouri

"VITAMIN A" DEFICIENCY IN POULTRY

The occurrence of a destructive disease of poultry, resembling an infection in its manifestations, but thought and now known to be caused by incorrect feeding methods, was discussed in the report of the California Agricultural Experiment Station[1] for 1919–20. The opinion in regard to the etiology of the disease was based upon (1) negative results of bacteriological examinations and failure to transmit the disease to healthy fowls by inoculation, and (2) on success in controlling the disease in several flocks by increasing the amount of green food in the ration, decreasing the proportion of meat scrap and eliminating cocoanut meal.

The disease is characterized by (1) a discharge from the nostrils; (2) an ophthalmia producing a viscid secretion which glues the eyelids together, followed by the formation of a tightly adherent white film over the membrana nictitans and the accumulation of a mass of white caseous material in the conjunctival sacs; (3) the appearance of white pustule-like lesions one half to 2 mm in diameter on the mucosa of the mouth, pharynx and esophagus; and (4) in the later stages, weakness and emaciation. These symptoms have often caused the disease to be diagnosed as a form of avian diphtheria or roup by veterinarians and poultrymen. Besides the above lesions, the most prominent changes found on autopsy are pale, swollen kidneys marked by a network of very fine white lines which are urate-filled tubules.

The results of controlled feeding experiments conducted by the writer in 1920[2] suggested that the disease was caused by a deficiency of some vitamin in the ration and experiments just completed have shown this to be the case. In these experiments eleven pens of fifteen fowls each were fed a basal ration of mixed grains and meat scrap properly balanced for poultry but containing no yellow corn. No other food was given in pen I, the control. In pen II the basal ration was supplemented by a salts mixture consisting of calcium carbonate, calcium phosphate, sodium chloride, sodium sulphate and iron sulphate; in pen III by buttermilk; in pen IV by cod-liver oil; in pen V by dried yeast; in pen VI by orange juice; in pen VII by cod-liver oil and dried yeast; in pen VIII by cod-liver oil and orange juice; in pen IX by dried yeast and orange juice; in pen X by cod-liver oil, dried yeast and orange juice; and in pen XI by lawn clippings.

None of the fowls in the pens which have received cod-liver oil or lawn clippings have been affected, but the disease has occurred in all other pens, affecting 11 of the 15 fowls in pen II, which were fed buttermilk, and all the fowls in the other pens.

These studies throw light on the etiology of a serious poultry disease which the writer has previously designated as "a nutritional disease resembling roup." We feel that we are now justified in using the more definite designation "Vitamin A deficiency," for this disease, although the term "nutritional roup" might be more suitable for general use among poultrymen.

J. R. Beach
Agricultural Experiment Station,
University of California

[3] *Biochem. Jour.*, XVII, 376–390, 1923.

[4] *Amer. Jour. Physiol.*, LXII, 162–176, 1922.

[1] Report of the California Agricultural Experiment Station, 1919–20, p. 79.

[2] Report of the California Agricultural Experiment Station, 1920–21, p. 140.

SCIENCE NEWS

MIRA, THE STRANGE STAR

Science Service

THE recent discovery of a very faint companion to the well-known variable star, Omicron Ceti, called Mira or the "Strange Star," is baffling astronomers and may necessitate a revision of present theories of the size and distribution of the stars.

In 1596 the Dutch clergyman, David Fabricius, noticed a strange star in the constellation the Whale, which he had never seen before. Later observations showed that the star was not constant but varied in light and was only visible for a short time every year. For this reason the star was given the name Mira, the "Strange Star." After more than three hundred years of observations astronomers thought that they had come a little closer to the solution of the mystery of this star.

It was found that the star varies from the second magnitude at maximum to the ninth magnitude at minimum when it is sixteen times too faint to be visible to the naked eye. The time in which these light changes take place has been determined to be a period of eleven months, or exactly 330 days. Examined in the spectroscope the star shows a spectrum which the astronomers at the Harvard Observatory call of class M which means that it is a red star. In contrast to the majority of red stars which are not variable, however, Mira shows bright lines due to hydrogen in its spectrum.

That is in short all the knowledge we had about this peculiar star until a few years ago. It was discovered at Mt. Wilson by Dr. A. H. Joy that when the star was at its feeblest the spectrum had a certain peculiar aspect which up to that time had only been ascribed to blue stars. It was therefore concluded that a blue star might be very close to the red star, but a search for this blue companion with the great telescope of the Yerkes Observatory yielded no results.

Repeating the spectrum tests, the blue star still seemed to be there and again the star was examined for duplicity, this time by Professor R. G. Aitken of the Lick Observatory. In the clear sky of California he succeeded in seeing a tiny little star close to the variable. The angular distance as measured in the telescope was only a second of arc, or equal to the angle spanned by an inch at a distance of three and a half miles. The little star was about half a magnitude or one and one half times fainter than the variable which at that time was of the ninth magnitude.

This discovery has baffled astronomers a good deal. They must choose between two alternatives: That the blue star and the variable are physically connected, or that they simply by mere chance seem to be together in the sky and may really be at entirely different distances from us. In the first case, since we know the distance of the larger variable approximately, we can tell that the blue star is in reality ten times fainter than the sun or ten thousand times fainter than any other blue star of that type. If, on the other hand, the stars are not physically connected and the blue star is of ordinary brightness, it must be 8,000 light years off and that lands it in a region of space where we know no other star of this kind. Observations in the near future will enable us to decide which of the two is the right conclusion, for the variable star itself has a motion in the sky which will decrease the distance between the two stars seven tenths of its value in three years.

When that time comes it may be found necessary to form a new and third hypothesis to account for its existence and peculiar behavior.

ELECTRICAL TREATMENT OF FIELDS

Science Service

YIELDS of grain have been doubled in some cases through the application of electricity to fields during experiments made by Professor Vernon H. Blackman for the electro-culture committee of the British Ministry of Agriculture and Fisheries.

The electrical discharge was from overhead wires, but was not applied during the whole growing season. Experiments so far completed demonstrate the extreme complexity of the whole problem, however, and further work is planned.

Earlier experiments in the field seemed to hold out little hope that electro-culture would ever become a commercial proposition. In these the discharge varied in the different trials from two to twelve ten-thousandths of an ampere per acre and the voltage varied from 25,000 to 56,000. The discharge was applied for from 6 to 8 hours daily from April to August. The cost of course was quite prohibitive, and the increase in crop yield was small and inconstant.

As it seemed nearly impossible to sift out the various possibilities working on a large scale in the field, later experiments were carried out, chiefly in the laboratory, or in pots, or in small scale plots. These experiments showed first that the very high voltages used in the earlier work, far from being necessary, were much less effective than much smaller ones. For instance, currents passing through plants of the order of one hundred millionth of an ampere were injurious in the case of the early vegetative stages of maize, whereas currents as low as three ten-billionths of an ampere had an accelerating action on growth.

It was also found that it was unnecessary to continue the discharge throughout the whole period of growth of the crop; but that one month's treatment was at least as effective as a continuous one. The second month of growth appeared the best time to apply the treatment. In one such case an increase in grain yield of 116 per cent. was obtained. It is interesting that in most cases of greatly increased grain yield the increases of total plant growth were very slight, indicating that the electrical discharge had stimulated the reproductive processes